Telephone Engineer

WITH WHICH IS CONSOLIDATED THE WESTERN TELEPHONE JOURNAL
ESTABLISHED 1902

VOL. X | CHICAGO, SEPTEMBER, 1913 | No. 3

PUBLISHED MONTHLY BY THE
ELECTRICITY MAGAZINE CORPORATION
Monadnock Building, Chicago.

Ed J. Mock and Paul H. Woodruff, Editors.
TELEPHONES: HARRISON 3014—AUTOMATIC 61028.

LONDON OFFICE.....86 Maiden Lane, Covent Garden
S. RENTELL & Co., Representatives.

Entered as second-class matter May 26, 1909, at the postoffice at Chicago, Illinois, under Act of March 3, 1879.

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico	Per year, $2.00
Canada	Per year, 2.50
Foreign countries within the Postal Union	Per year, 3.00
Single Copy	.20

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CHICAGO, SEPTEMBER, 1913.

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PRICE MAINTENANCE.

PRICE maintenance of retailed goods is just now at a crucial point in its history. Recent court decisions, if not entirely condemning the principle, have at least indicated that it may be easily abused to the extent of becoming illegal. As a consequence, some manufacturers who have been accustomed to insist on price maintenance by their retailers have abandoned the practice, while others are resorting to various more or less clever deviations from the old custom.

This uneasiness, which is of so much import to the general manufacturing field, scarcely interests the telephone man at all. There is not, nor has there been, any effort to maintain the selling price of telephones and telephone apparatus.

The telephone business is not, of course, analogous with other lines of business whose product is sold through jobbers and retail stores. The installation of a new exchange, or new equipment in an old exchange, is a contract which goes, other things being equal, to the lowest bidder. When, however, the lowest bid is so low as to leave no possible margin of profit, or even to result in an obvious loss to the contractor, one is tempted to believe that, in spite of the apparent legal aspect, there may be merit in an association of some sort which will keep its members from committing commercial suicide.

Telephone operating competition may be at a low ebb; but the same cannot be said for telephone selling competition, which seems to be as bitter and warlike as ever—or even more so. This condition is, of course, pleasing to the buyer, who sees only the gain to his pocket book and generally does not realize that the particular brand of equipment he chose because of its extraordinarily low price may be the first to be forced out of the market because of that very policy. Even a buyer must realize that the price he pays must give the seller a profit, or the day will come when he cannot buy it at all.

Whatever the attitude of operating companies toward each other, it is a pity that greater harmony cannot exist between the manufacturers of telephone apparatus, that all may survive in prosperity and give the operator a choice for all time.

BUILDING ON HABIT.

THE natural and most efficient scheme of conducting business is to build on habit. The specialist is superior to the Jack-of-all-trades. This fact has been known for centuries, but never before have conditions existed which have so forcefully demonstrated it. It applies to the business and commercial side of the industries as much as it does to the manufacturing side.

The skill of the workman is due to his continual

application to his own particular work. A lathe hand cannot turn out his best day's work without his own lathe and his own tools, his own bench and work and general surroundings. Give him another lathe of even the same "make," and it may be days before he attains his previous record. Change his work frequently, and you have reduced his output.

This condition is found through all kinds of work in manufactory and office.

There is a misuse of energy when specialization is not practiced, and in such dissipation of energies there has been wasted something that is of greatest value. The individual has had the pleasure of working very hard, but at the end of the week or year or life it is clearly apparent that the plan of work has been faulty. It has gone contrary to the most efficient scheme, and the awakening from the dream is unpleasant.

We do a great wrong to men when we direct or restrict them to performing their work inefficiently. Congenial labor is, we know, one of the greatest blessings in this world. It is a greater blessing to the worker than to any one else, but it should be rightly directed by those in positions to direct. If it is allowed to be expended in effort that goes contrary to all natural laws, there is a great loss to the world, to the industry and to the man. The drone is of more use to the world than the man who misdirects labor as James Hartness says in the Transactions of the Efficiency Society, Inc.

RATE REGULATION.

EVEN to tabulate and mentally assimilate the different rates of the different telephone companies operating in any state is a task which no commission can hope to accomplish immediately upon its appointment. Yet the new commissions are trying not only to absorb that information, but in addition are boldly attacking the vastly more intricate problem of readjusting such rates. That this condition may be a consequence of the impatience of the public for results, and the continual pressure of the press, seems likely. When it is remembered that each commission must consider not only telephone, but electric light and power, gas, railway and water rates, the impossibility of adequate consideration is a period of a few weeks or months will be appreciated. The condition is commented on by William J. Norton, secretary of the Rate Research Committee of the National Electric Light Association, in a paper read before the convention of the Michigan section, held August 20, and we quote such of his remarks as are pertinent to the telephone industry:

Ten new public-service commissions have been established in 1913. Before the summer is over 50 new commissioners may be trying to determine in these ten states, exactly what rates are just and proper. How can they do it? Their mere appointment by the governor gives them no supernatural ability or experience, as though by a fairy wand.

Upon taking office they will find a vast amount of purely administrative detail which must be mastered. If they are all well trained executives and there were nothing else to do this detail might be well out of the way within a year; but if the experiences of some of the other states are repeated, they will immediately have important cases thrust upon their dockets, or, in the attempt to create the impression that they are accomplishing something, they will demand of the companies under their jurisdiction enormous quantities of information, including complete summaries of books of account, entire inventories of all property, and a great mass of other information which will involve the companies in great expense and which, as a rule, the commissions will be utterly unable for a long time, if ever, to digest.

The main trouble is that some of the commissions have quite failed to realize that public-service regulation should be properly divided into two separate epochs: (1) The Preparatory Period of Regulation; (2) The Final Period of Regulation.

The states for years have had the right to regulate the public-service companies. It is only recently, however, that they have seen fit fully to exercise this right and delegate the regulating authority. In the meantime the utilities under the law have established certain methods of doing business.

Rates originally on a purely bargain basis, have slowly emerged through the efforts of the companies themselves, to the point where most schedules are published, and with the exception in some cases of certain old contracts which have not expired, all rates are open to the public and are not discriminatory.

Many companies have in recent years established proper depreciation or reserve funds. While in general these funds are not built up to the point where they are entirely adequate, a good beginning has been made as a matter of conservative financing. This was again entirely through the efforts of the companies, and without any suggestion or help from the state.

Very few companies have been able to make complete valuations, mainly because they have not felt that they could afford out of operating revenues, to incur the expense. Uniform accounting methods have been started, and the bookkeeping of the more recent years is correct in that it shows a proper discrimination between capital and operating charges.

In the matter of service, the companies have developed, even in many of the small cities, a service which is practically beyond criticism and all this has been done without any force or compulsion on the part of the state.

Some of the bigger companies in attacking the problem of economic development, have already begun to extend their service over a large territory. In doing so they meet the difficult problem of proper merging and consolidation, and while the public is greatly benefited in the end by such a development, it has sought to retard this progress by state laws which are based upon a mistaken, and now discarded economic theory.

This is the actual condition which confronts a commission upon its appointment.

The public, on the other hand, with a seemingly unbounded faith in miracles, believes that all of these problems can be settled immediately and that rates all along the line will be immediately reduced, and all of the so-called corporation evils will be at once ended and the millennium speedily attained.

Unfortunate indeed is the commission that shares in such belief. The really successful commissions, and the ones which have enjoyed the best reputation, are the commissions that have considered that a period of preparatory regulation must be allowed, and that their main duty in this preparatory period consists in making such orders that the public-service companies can adjust themselves to the new set of theoretical conditions which heretofore have not obtained.

This is not at all a new idea. The Wisconsin and the New York Commissions have undoubtedly had this idea in mind in all of their regulation. The Massachusetts Commission has always refused to accept the modern theory of valuation as a panacea for all troubles, and has, for a period of over 25 years, attempted to regulate the companies under its jurisdiction to the point where they could accept the theoretical regulation without placing an undue burden upon the companies. It is a striking fact that the Massachusetts Commission, which started to regulate companies in 1887, has not yet completed its work of adjusting the companies under its jurisdiction and that this preparatory period is still in existence.

And yet some of the new commissions may attempt, immediately upon their appointment in important cases, to apply the most theoretical regulation, and hopefully trust that the company will survive.

The writer does not believe that the first or preparatory epoch of regulation in all cases will be as long as twenty-five years. It will probably extend through the average life of the plant furnishing service, so that for the electric utilities we may consider that the preparatory epoch of regulation should last for from 15 to 20 years. Some of the larger companies, whose methods of accounting and provision for depreciation are more advanced, might reach the second period or epoch of theoretical regulation in a shorter time, and of course the sooner such a period can be reached the better it will be, not only for the public served, but also for the commissions which are charged with the responsibility of regulating, and also for the companies which are under regulation.

Let us assume that all these newly appointed commissions accept this point of view, namely, that proper public service regulation should be divided into two epochs, the first an epoch

of preparatory regulation, in which the effort of the commission shall be directed to so adjusting its orders and regulations, that ultimately a second epoch may be definitely reached where theoretical regulation may apply without any unfairness or harm either to the public or to the corporation being regulated, then such a commission will meet with and in a co-operative spirit help to solve the following problems.

VALUATION.

Few companies have valued their own plants, and when the commission is confronted by a rate problem, some of the laws require that it must solve the problem by valuing the plant of the utility. The result of a valuation is a matter in which engineers honestly disagree in most cases by about fifty per cent, and the Supreme Court says the subject is still "up in the air."

The commission might better establish a joint valuation board, which has the confidence of both the commission and the companies. Such a board without any undue haste could begin to establish values throughout the state where such work was considered absolutely necessary, or required by law. The men in charge of such valuation should be men of experience and integrity, and the bases of valuation should be carefully worked out. The history of the utilities should be fully studied and every element of value should be investigated and determined.

Capitalization as it exists should be considered not as a crime committed by the company, but as a method of finance heretofore approved and often encouraged by the laws of the state. If there are any elements in the capitalization which cannot be approved in the future, the commission should provide means for the gradual amortization of such capitalization during the preparatory epoch of its regulation. Through it all there should be the greatest amount of co-operation between the companies and the commission. The advice of the ablest utility operators in the state should be frankly sought and considered by the commission in the effort to reach the second epoch of theoretical regulation as early as possible.

DEPRECIATION.

Many companies will be found to have no depreciation funds, or inadequate ones, generally through a lack of surplus income rather than any direct intent. The commission must now start to help such companies build up their funds to a normal position. And here a liberal policy will be the best. It is always a most difficult matter to build up a depreciation fund, and both the public which is being served, and the company are better off if a fund is too large rather than too small. Any minute discussion of the advantages of such theories as the sinking-fund basis or straight-line basis, etc., in the early preparatory epoch is entirely out of place, and the commission should direct that depreciation funds be built up just as fast and just as liberally as the rates will allow.

RATE OF RETURN.

Utility companies of the country have in general been operating since their establishment, upon the usual commercial basis which has made a virtue of making as much money as is possible. The modern theory of regulation demands that, as utilities are monopolies, the commercial basis should be discarded and a strict and definite rate of return should be established immediately. The municipalities generally and the commissions sometimes entirely neglect to consider that this means a complete reversal of the entire financial and executive policy of the company and if the newer policy is a good one and is to be maintained, commissions should again make such adjustment as would allow the companies in their financial transactions to slowly but gradually accommodate themselves to the stated rate of return. The public in the end is better served by liberality on this score, even if such liberality is only temporary, than it would be by such a drastic ruling as would injure the financial stability of the company, and make future extensions and development difficult.

ACCOUNTING.

There is not much which the commissions can do for the larger companies in the matter of accounting. For the smaller companies, however, there still remains some work to be done and a considerate commission, carefully watching the detail which is required of the small companies, may accomplish a great deal of good.

RATES.

The most difficult problem of all for a commission to solve is the matter of rates. Mr. Stevens, formerly chairman of the Second District Commission of New York, says in his report on the Buffalo rates, that while valuation and the establishment of a fair rate of return are difficult matters, they are nothing as compared with the determination of fair rates for each classification in the schedule.

Valuations are proper guides for total revenues, rather than for specific rates. Valuations may be of some use in rates adjusted absolutely according to the cost of service, but it is obvious that rates must as a whole lie somewhere between the cost of service and the value of the service to the consumer.

The writer believes that the commissions should, at the very beginning of their administration, assume that they have before them an epoch of from ten to twenty years, which can be best used by them in assisting in adjustments to be made by the companies themselves, in preparation for a second or final period of regulation, in which pure theory may be applied without harm either to the public or the companies. Such a position would produce early in their administration a spirit of co-operation on the part of the companies and eventually with the public, which will do a great deal more to bring about the desired result than any drastic or bitter regulation could ever accomplish.

However, the writer wishes it clearly understood that in advocating a preparatory epoch of regulation by commissions, he does not mean, in any sense, that such a period should be without benefit to the public.

SELF REGULATION.

After all there is nothing in public-service regulation which the company itself cannot accomplish, and it is a very poor policy indeed for a company to wait until the public or a commission forces it to do things which it should have done on its own initiative. In such matters as the form of schedules and uniform accounts the commission through its authority can greatly help the entire situation, but in the matter of the publicity of rate schedules, in the adoption of a proper method of providing for depreciation, or in a study of rate forms, and in the actual making of rate adjustments or reductions, there should be absolutely nothing for a commission to do for an energetic and up-to-date company.

CO-OPERATION.

There is one point, however, where a commission can be of great assistance to the companies and that is in overcoming the existing unfair prejudice against utility corporations. The writer is frank to say that he personally believes that any commission that assumes the position of open hostility in any of its dealings with the utilities has thrown away all of its opportunity for usefulness.

All unfair attacks upon corporations by the public or by the politicians, or any attempt of the politicians to foster or make use of this feeling against the corporations for their own purpose, should be as relentlessly and fearlessly attacked by the commission as any unfair or unlawful action on the part of the company. It is only by maintaining a helpful attitude that a public service commission will endure, and it is gratifying to note that the existing commissions have generally evidenced a keen appreciation of this axiom.

THE FARM'S FIRST AID.

IN THIS day of organization the farmers are about the only people who are not organized in some way, says P. C. Henry of Catawba county, N. C., and it is a recognized fact that they, too, must co-operate in some way to come into their own. I do not believe there is any one agency that will assist the farmers of a community to co-operate so quickly and so well as the rural telephone. It seems that one of the chief reasons that keeps most communities from building such a rural line is the belief that it takes a high-priced expert to build the line and keep it in operation, also the false idea as the cost of building such a line. I will give my experience in building such a successful rural telephone line in my neighborhood, hoping that it may persuade other communities to do likewise. In the course of a year we have found the rural telephone line of utmost value in the saving of unnecessary steps and drives.

All who agreed to put in a telephone met at the home of a member and organized as the ——— telephone company. A committee was then appointed to see the

manager of the central office in the nearby city regarding the help they would extend us, for they were anxious to have new lines built. They agreed to meet us one mile from the city limits with their wires, which reduced our cost considerably. It was then agreed that the company was to build the main line and each member to build from the main line along the public road to his house. The cost of one share in the main line came to $10, the main line being seven miles long, and 14 members to the line. The telephones were all ordered together and we got a very good one for $11 on which we can easily speak and hear 40 miles through the central office. We built the metal circuit system, having two wires, for we were told by the manager of the central office that the one-wire system could not be depended on frequently, so that it would pay us better to put up the two wires at once. Our total running expenses amount to 50 cents a month, for which we get very good service at the central office. Our company charges 10 cents' toll for all who use the line outside of the member's family, and this toll pays to keep up the line and nets a surplus.

When we were ready to build, two men staked off the spaces for the poles 160 feet apart, placing the poles in as straight a line as possible. Eight men followed with posthole implements. The members furnished heavy oak poles and were allowed 40 cents a pole. We used stout poles throughout and it is well that we did, as 14 new members wish to use our poles and erect two more wires. Having nailed the brackets on the poles, we made use of a handy device to assist in setting the poles. Two pieces of scantling about 8 feet long were bolted together 18 inches from one end, while a strong wire at the other end permitted the apparatus to open wide enough for the pole to rest upon. Three men lifted the pole, while a fourth guided the pole into the hole. The above device was then placed beneath for the pole to rest on, while two men with long spikes pushed the pole upward until it dropped into the hole. Ground was then thoroughly tamped around the poles and they were ready for the wires. In stretching the wires we found it best to stretch and tie the lower wire first, to avoid any undue slackness in the top wire.

The advantages of such a rural telephone line are very many. At any hour of the day or night we can now call a physician when needed. Quite recently a little boy got his arm caught in a cotton gin 10 miles from town, and our ever-ready telephone line saved him from bleeding to death, which would have happened had a messenger been obliged to ride to town for a doctor.

The lady of the house now feels perfectly safe when she happens to be home alone, for she can quickly summon aid when needed. She can speak daily to her friends in town or country, and she no longer dreads the former isolation of farm life. Before leaving for town with a load of produce, hay or cotton you can call up the parties you wish to trade with and know exactly what they can offer. The telephone is a great help in learning about the cotton market and to keep in close touch with the prices.

I helped to put in the telephone for a neighbor recently and the first message over the wire saved a round trip to town. His son had started to town that morning. A certain medicine was needed, but it was forgotten to tell him about it. So we called up the hardware store where he was going and we gave the merchant the message for the boy about the medicine that was needed, which saved an extra trip to town, 20 miles. So my opinion of such a rural telephone line is, that you can't afford to do without it.

WHO IS BOSS?

A BUSINESS man bought a farm for a diversion, to help balance the day of work.

Riding across his fields at an unexpected hour one morning, he found several men sitting by the roadside.

One of the men sprang to his feet when he saw the "Boss" arriving. Then, in a piping voice, he said, "I want to be farm-boss!"

"What's that you say?" shouted the proprietor.

"I want to be farm-boss," repeated Bennie, all undaunted.

"Why don't you be farm-boss? Nobody has hindered you. You have every opportunity."

"You just tell the men, now," persisted Bennie, "that I am the farm-boss, won't you?"

The farm-boss evolves. So does the superintendent. So does the manager. So does the man who is responsible for the business.

But in every factory, shop and place of industry, where many people are employed, some of the workers are named Bennie.

Bennie thinks that all there is to being Boss is to have somebody say he is.

You cannot explain to Bennie that, "Where MacGregor sits is the head of the table."

You can never explain to Bennie, had you all the gifts of the gods, that the Boss is he who does the most work. Bennie will never know that, with every command that the Boss gives, there goes the responsibility that he may be wrong, and that the Boss must have the power within himself of making good every one of his own mistakes and the mistakes of all who work for him. The Boss never resigns, and in the darkest hour that can come has only one thought, and that is to stay with the ship. The Boss is he who can carry off the Gates of Gaza. The Boss is he who is big enough to say, "The mistake is mine; I am wrong—I will make this right," and he does.

The Boss is he who is big enough to take any criticism, and takes the criticism that he does not deserve with as good grace as he does the criticism which is deserved.

The Boss is he who is willing to start things, stand by them through their entire making, finish and complete them.

The Boss is he who is capable of saying, as did Napoleon, "The finances, I will arrange them."

The Boss is he who finds his completest joy in playing the game, seeing the finish, and being ready for a new task.

The Boss is he who demands of himself more than he demands of all the rest of his people.

The Boss is the one who makes good.—*The Fra.*

A $20,000 company has been formed to operate a system of telephones in several towns near Rio Chico, east of Caracas, Venezuela, near the coast. The present system is to be extended. The name of the company is Teléfonos de Barlovento.

Experiments with wireless telephony between Nauen and Berlin have proved the efficiency of this method of communication. It was possible to telephone an entire newspaper account over a distance of 400 km. The great success must be laid to the employment of the high frequency machines of the Telefunken system used in these experiments.

Test of an Artificial Aerial Line

By A. E. Kennelly and F. W. Lieberknecht*

IT is the purpose of this paper to describe in detail a series of measurements of voltage and current made, in February, 1913, over an artificial telephone line 800 km. (nearly 500 miles) long. Although it is possible to compute the behavior of such a line when its electrical constants are known, yet this is the first time, so far as the authors are aware, that an artificial aerial line has been measured both as to amplitude and phase of voltage and current, with less than 2 volts of 750 cycles-per-second frequency impressed at the sending end.

The artificial line used in these measurements is the one permanently installed in the Graduate School of

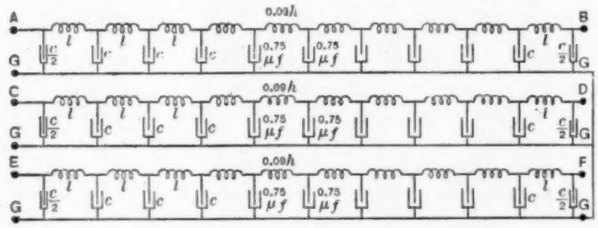


Fig. 1—Diagram of Connections of Artificial Line.

Applied Science at Harvard University. In order to convert this artificial line, originally designed as a power-transmission line, into an aerial telephone line, small non-inductive resistances were uniformly inserted in the line, one to each section.† These resistances added 100 ohms per section of 80 km., or increased the nominal linear resistance from about 0.3 ohm per wire-km., (0.48 ohm per wire-mile), to about 1.55 ohms per wire-km. (2.5 ohms per wire-mile), corresponding approximately to one of a pair of copper overhead telephone wires of copper 3.75 mm. (148 mils) in diameter. That is, one and the same artificial line of coils and condensers can be made to serve either as an artificial aerial power-transmission line, or as an artificial aerial telephone line,

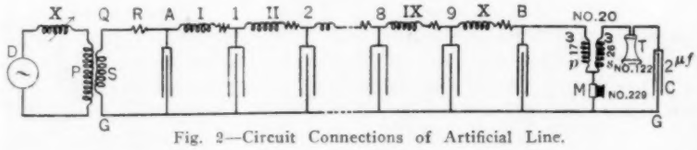


Fig. 2—Circuit Connections of Artificial Line.

by respectively cutting out or in the non-inductive resistance attached to each section, thereby changing the line for low frequency from about No. 0 B. & S. gage (8.3 mm. 0.325 in. diameter) to No. 7 B. & S. gage (3.65 mm. 0.144 in. diameter).‡ The total available length of line in each case is 2,400 km. (1,491 miles), only 800 km. (497 miles) being employed in the tests here reported.

*Paper presented at the 30th annual convention of the American Institute of Electrical Engineers, Cooperstown, N. Y., June 24th, 1913.

† These resistances were made of about 6 meters of No. 32 A. W. G. *Ia-Ia* (0.2 mm. 0.008 inch bare diam.) double-cotton covered resistance wire, and were wound non-inductively on fiber strips 8 cm. long, 2.5 cm. wide, and 0.3 cm. thick, soldered to terminals on the same, and covered in solid paraffin wax. These resistances carry 0.5 ampere without serious heating.

‡ The line actually behaved, at telephonic frequency, like one of a pair of No. 0 A. W. G. copper wires (2.9 mm., 0.114 in. diam.), owing to the combined influences of capacity between the layers of the coil winding, and the lumpiness of the line-section. See Table VI.

For the constructive details of the line it may suffice to say at this time that the line used was a II-line of ten sections, with ground return, the connections being indicated in Fig. 1. The constants for the line appear in Tables I and II. In the design and construction of an artificial aerial telephone line *per se*, not intended to serve also as a power-transmission artificial line, it would be unnecessary to use as much copper as in the artificial line here described. It would also be desirable to subdivide the inductance and capacity into smaller but more numerous sections for frequencies much above 1,000 cycles per second. In the line here described, there were five sections per actual wave-length, at 760 cycles per second.

It will be observed that whereas the apparent inductance of the artificial line is the same at both telephonic and lighting frequencies, the apparent leakance is more than ten times greater at the telephonic frequency while the apparent resistance is nearly four times less, and the apparent capacitance 11.3 per cent less. In other

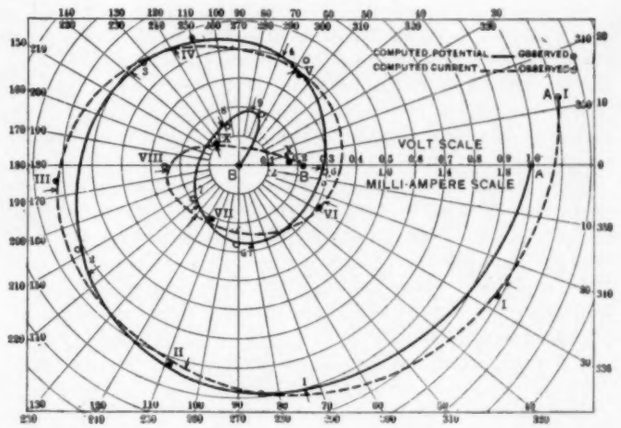


Fig. 3—Line Grounded at Distant End. Vector Diagram of Voltage and Current.

words, the effect of increasing the testing frequency on the artificial line from 60 to 760 cycles per second, is to change all the constants except the inductance. Each coil behaves as though its resistance were 33 ohms instead of 125.6. Its condensers (paper dielectric) behave as though their capacitance had fallen 11.3 per cent while their leakance had risen some ten times. It is known that paper condensers are subject to such changes with rise of frequency. The great apparent reduction in coil resistance can, however, only be attributed to the effect of capacity between the layers of the windings. This deduction was supported by tests made on the coils alone, at telephonic frequency.

Generator. The alternator used was a Cahill multi-frequency generator employing a number of stator armatures side by side, with internal rotor field magnets on the same shaft, giving respectively 2, 4, 8, 16, 32 and 64 cycles per revolution. It was directly coupled through a leather-strip coupling to a 500-volt, four-kw., four-pole

direct-current motor. Each of the component alternator armatures was rated at about 500 watts output. Only two of the armatures were used, namely, those giving 2 and 32 cycles per shaft revolution. When running at 1,425 rev. per min. or 23.75 rev. per min., these armatures delivered frequencies at 47.5~ and 760~ respectively. The former was used to supply a Frahm vibrator

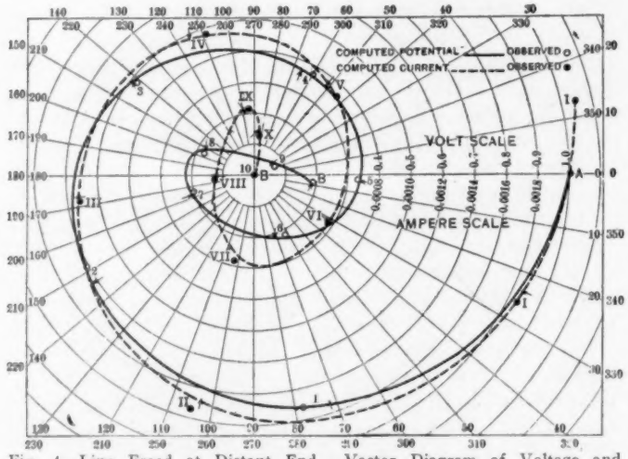


Fig. 4—Line Freed at Distant End. Vector Diagram of Voltage and Current.

frequency indicator, and the latter for the test of the artificial line. When the frequency meter indication was steady at 47.5~, the artificial-line frequency was known to be 760~. By leading the shunt-field circuit of the driving motor into the artificial-line room, an adjustable field rheostat in this room enabled the driving-motor speed to be kept constant, and thus also the alternator frequencies.

Frequency.—The reason for selecting 760 cycles per second for testing the artificial telephone line was that this is near to the standard telephone frequency of 5,000 radians per second (795.8~) which has been accepted internationally. It is also known to be near to the fundamental frequency of the diaphragms of the standard receiving telephone used.

Circuit Connections.—The circuit connections of the artificial line are indicated in Fig. 2. The alternator stator armature *D* delivered 40 volts at 760~ in the testing room. A step-down transformer, *P S*, lowered the voltage to about 1.75 volts at secondary terminals *G Q*. The adjustment was made by inserting an adjustable reactance *X* in the primary circuit, partly for the purpose of reducing upper harmonics in the wave of secondary voltage. The voltage wave-form was somewhat peaked. That is, a symmetrical third harmonic was perceptible; but no analysis of the wave form was attempted. The secondary terminal *Q* was connected to the end *A* of the artificial line through a non-inductive resistance *R* of 100 ohms. The other secondary terminal *G* was connected to the ground return of the artificial line, and was also carefully grounded.

Three series of tests were made, namely, with the distant end of the line (1) freed, or open, (2) grounded, and (3) connected to ground through a standard subscriber's set.

The third condition is indicated in Fig. 2.

Telephone circuits actually employ metallic return, and not ground return; but all tests on ground-return artificial lines are immediately interpretable on metallic-return or loop basis. These tests correspond to applying 3.5 volts at the sending end of a loop, and two subscriber's sets in series at the receiving end.

METHOD OF MEASUREMENT AND APPARATUS USED.

The potential and current along the line in the steady state were measured by means of a Drysdale a-c. potentiometer, using a Duddell vibration galvanometer. The Drysdale instrument was described with some detail in our A. I. E. E. paper of last year, above mentioned. Since the potential on the line nowhere exceeded 1.8 volts, the potentiometer was able to read the potential at any junction point directly, without the intervention of a multiplier or step-down transformer. In order to find the current strength, the drop of potential in the 100-ohm inserted section-resistances was measured.

The Duddell vibration galvanometer was tuned to the testing frequency and operated with the aid of an arc lamp. The spot of light was thrown on a white wall several meters away, so that it was easy to see when balance was secured and the spot of light brought to rest, from almost any part of the testing-room.

The 760-cycle-per-second voltage was raised to nearly 140 volts by a step-up transformer, and impressed on the split-phase angle measurer of the instrument. The phase balance required about 0.043 micrafarad and 340 ohms, inserted in the associated shunt circuit of the split-phaser. This split-phase balance had to be checked and adjusted occasionally.

METHOD OF OBSERVATION.

In making a series of tests along the line, the impressed e.m.f. and frequency at *A*, Fig. 2, were kept as nearly constant as possible. One observer watched the Frahm frequency meter, another changed the potentiometer leads along the line and watched the vibration-galvanometer arc-lamp. A third adjusted the potentiometer balance for amplitude and phase. Each voltage could ordinarily be measured to 0.001 volt, or closer, in amplitude and to a tenth of a degree in phase. This voltage represented either a potential from some junction point on the line to ground, or the potential drop in a section 100-ohm resistance. In working out the results, they were all reduced by simple proportion to what would have been observed if the impressed e.m.f. at *A* had been just 1.00 /0° volt instead of the 1.7 volts, or thereabouts, actually measured. This reduction was made for greater simplicity in presenting the results.

TABLE I
ELECTRICAL CONSTANTS OF TEN-SECTION ARTIFICIAL LINE AT 60 ~

	Resistance at 20° cent. ohms	Inductance henrys	Capacitance microfarads	Leakance micromhos	Hyp. angle hyps.
Whole line....	1256	0.913	7.5	120	1.08 /71°.5
Per section..	125.6	0.0913	0.75	1.2	0.108 /71°.5
Per wire-km.	1.57	1.14×10^{-3}	9.38×10^{-3}	0.15	0.00136 /71°.5
Per wire-mile	2.53	1.84×10^{-3}	15.1×10^{-3}	0.24	0.00219 /71°.5

TABLE II
ELECTRICAL CONSTANTS OF ARTIFICIAL LINE AT 760 ~

	Apparent resistance at 20° cent. ohms	Apparent inductance henrys	Apparent capacitance microfarads	Apparent leakance micromhos	Hyperbolic angle Hyps. /_	Surge impedance ohms /_
Whole line..	330	0.9136	6.656	1660	12.94 /79°.5	465 \11°
Per section...	33	0.0914	0.6656	166	1.294 /79°.5	465 \11°
Per wire-km...	0.413	1.14×10^{-3}	8.32×10^{-3}	2.075		
Per wire-mile...	0.665	1.84×10^{-3}	13.4×10^{-3}	3.34		

RESULTS.

The results obtained are indicated in Tables III, IV and V for the condition, at the *B* end, of grounded, open, and through subscribers' set, respectively. Referring to Table III, the first column denotes the test-points along the line. Arabic numerals designate junction-points between sections, and Roman numerals mid-section points (see Fig. 2). The distances in kilometers of these points from the distant end of the line appear in column 2. The hyperbolic angle δ, of each point from *B*, is given in the next column, expressed as a complex quantity, the real component being a hyperbolic angle expressible in hyperbolic radians, and the imaginary, or *j*-component, a circular angle expressed in circular radians. This *j*-component measures the wave phase-length of the line at the frequency considered. In this case, the wave-length of the whole line *AB* is shown to be 12.723 circular radians. It is convenient for many purposes, however, to divide the *j*-component by $\pi/2$, or 1.5708, in order to reduce this circular angle to quadrant measure. This reduction appears in the fourth column. The whole line *AB* subtends a complex hyperbolic angle $2.350 + j\ 12.723 = 12.94\ \underline{/79.5}$ hyps., of which the *j*-component is 8.1 in quadrant measure. That is, the wave

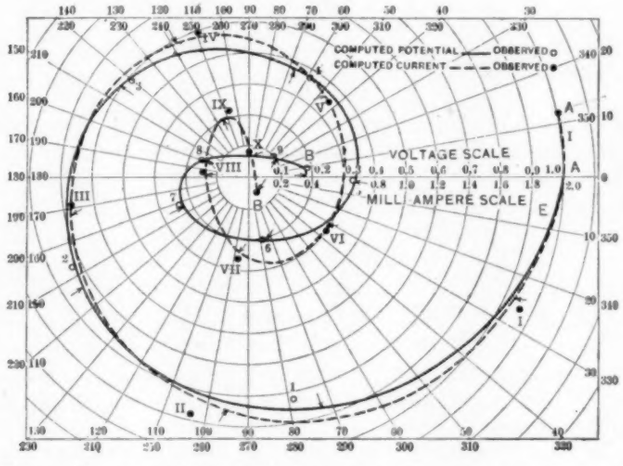


Fig. 5—Line Grounded Through Subscriber's Set. Vector Diagram of Voltage and Current.

phase-length of the line is 8.1 quadrants, or a little more than 2 complete revolutions. In other words, the artificial line at this frequency covers a little over 2 complete wave-lengths, and the equivalent smooth line corresponding to the artificial line of junctions, would also cover a little over 2 complete wave-lengths. This hypothetical equivalent smooth line which would conform electrically to the lumpy artificial line at junction points, may be briefly denoted as the *imitated line*.

The fifth column of Table III gives the hyperbolic sine of the angle δ at the respective artificial-line junction points. The potential along the artificial line from junction to junction, and on the imitated line at all points, follows sinh δ in simple proportion. The voltage E' so computed, appears in column 6, starting with $1.00\ \underline{/0°}$ volt at sinh $\delta = 5.2\ \underline{/9°.2}$, phase angles appearing as degrees and decimal of a degree. Column 7 gives the corresponding observed junction-potential in magnitude and phase with the aid of the potentiometer, taking the initial impressed voltage as $1.00\ \underline{/0°}$ volt. It will be noticed that the agreement between the computed voltage E' and the observed voltage E is satisfactory, the magnitudes usually agree within 5 per cent and the phase within 5 deg. A discrepancy of 5 deg. may seem considerable in itself, but the total change of voltage phase along the line is about 720 deg.

Column 8 gives the hyperbolic cosines of the mid-section angles. It has been shown that the current in any II-section of an artificial line, when multiplied by the hyp. cosine of a semi-section, agrees with the current on the imitated line at the corresponding point; also that the

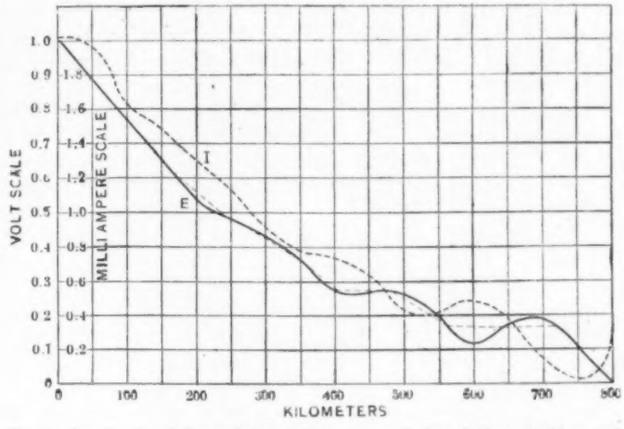


Fig 6—Amplitude of Potential and Current on Imitated Smooth Line and Amplitude of Potential on Artificial Line, Grounded at Distant End.

current at any point of a smooth line is directly proportional to the hyp. cosine of the angle from the distant end. Column 9 gives in this way the computed current at the points on the imitated line corresponding to mid-section points on the artificial line. Column 10 gives the observed section current *I*, and the last column gives *I* cosh *u*, cosh *u* being for this line, the vector $0.813\ \underline{/5°}$. The agreement should be exact, theoretically speaking, between the entries in columns 9 and 11 under *I'* and *I*

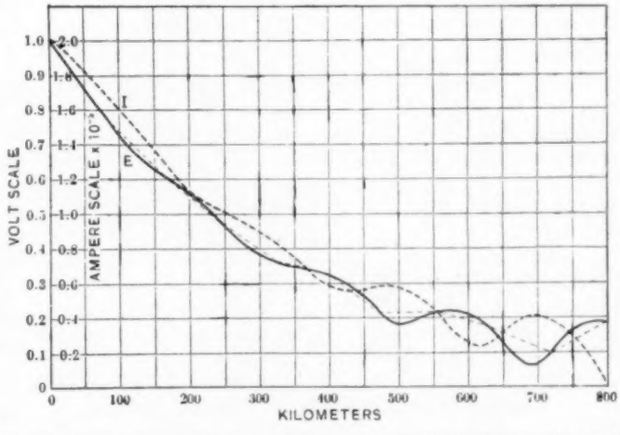


Fig. 7—Amplitude of Potential and Current on Imitated Smooth Line and Amplitude of Potential on Artificial Line, Freed at Distant End.

cosh *u* respectively. It is not exact in the case considered, but is nevertheless satisfactory.

Table IV gives the corresponding computed and observed potentials and currents with the distant end free. Here the free end of the line constitutes an initial line angle of $j\ \pi/2$ or j 1.5708 radians at *B*, or just 1 quadrant, which has been added to all the angles. The voltages follow the sines, and the currents the cosines, of the an-

gles from point to point. The agreement is again satisfactory, although by no means exact, between E' and E, also between I' and I cosh u.

Table V gives a similar comparison of computed and observed potentials and currents for the case of the line grounded at the distant end through a subscriber's set which offered an impedance of 1570 $\angle 70°$ ohms, and which therefore subtended a terminal angle of $\tanh^{-1}\left(\frac{1570\ \angle 70°}{465\sqrt{11°}}\right) = 0.043 + j\ 1.285$ hyp.; or, with the j-component in quadrant measure, $0.043 + j0.818$, the surge-impedance of the artificial line being 465 $\sqrt{11°}$ ohms. All the angles of Table III are here increased by these amounts. The potentials are then simply proportional to sinh δ, and the currents to cosh δ, as before. A satisfactory agreement is found between the columns under E' and E; and also under I' and I cosh u.

Figs. 3, 4 and 5 are vector charts, corresponding respectively to Tables III, IV and V. Referring to Fig. 3, with Table III, it will be seen that the potential at A

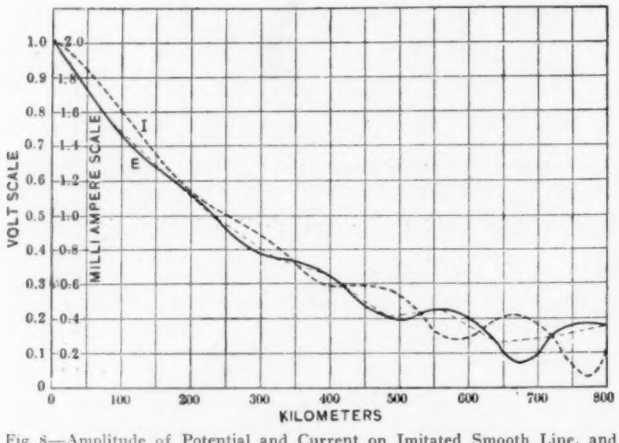


Fig 8—Amplitude of Potential and Current on Imitated Smooth Line, and Amplitude of Potential on Artificial Line, Grounded through Set at Distant End.

commences at 1.0 $\angle 0°$ volt. The continuous curve then traces the hyperbolic-sine locus of potential along the imitated line, both in magnitude and phase, it being understood that equal distances in kilometers do not generally correspond to equal phase differences. The arrowheads, intersecting the potential curve, mark the points on the imitated line at 80-km. intervals, corresponding to the junctions of the artificial-line sections. A small circle marks the corresponding vector potential observed. The arrowheads and circles should coincide, theoretically. Similarly, the broken line traces the computed hyperbolic-cosine locus of the vector-current along the imitated line, arrowheads indicating points at 80-km. intervals corresponding to mid-sections on the artificial line. The black dot circles mark the reduced current measurements. These arrowheads and black dots should also coincide, according to theory.

It will be seen that the current leads the impressed e.m.f. at A by 12 deg. As we advance down the line, both potential and current fall behind the phase of the impressed terminal e.m.f. The change in phase is about 720 degrees for potential, and 732 degrees for current; or about 0.9 deg. per km.

In the case of Fig. 4 and Table IV, it will be noted that freeing the line at the distant end, slightly diminishes the current at the sending end, without materially affecting its phase. Towards the distant end of the line, the magnitude and phase of the current are, of course, increasingly affected.

Figs. 6, 7 and 8 show the computed magnitudes of voltage and current along the imitated line without respect to phase. The broken dotted straight lines indicate the correspondingly computed magnitudes of voltage along the artificial line, on the assumption that the resistance and inductance are uniformly distributed in each sec-

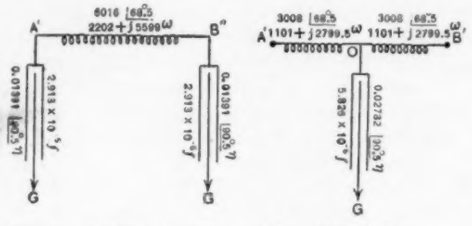


Fig. 9.—Nominal II and T of the Imitated Line.

tion coil; also that the capacitance between the coil windings can be ignored. The voltages at section-junctions and line-terminals then agree with those of the imitated line at such points. The current strengths in the artificial line would, if shown on the diagram, be constant in each section, and would be represented by horizontal straight lines, broken by vertical descents at leak-junctions. When multiplied by cosh u, these currents would agree with the imitated line currents at mid-section points.

In the case of Fig. 6 and Table VI, the current strength arriving at the subscriber's set is 0.115 $\angle 62°$ milliampere. The potential difference at the terminals of the receiving telephone T was 0.040 $\angle 230°$ volt, and taking the impedance of this instrument at 260 $\angle 40°$ ohms, as found by subsequent experiments, the current received in the instrument would be 0.040 $\angle 230°/260\ \angle 40° = 0.154\ \angle 270°$ milliampere. This current gave rise to a loud musical note in the receiver.

EQUIVALENT CIRCUITS OF ARTIFICIAL AND IMITATED LINES.

Table VII contains data concerning the artificial line taken as a whole, and also concerning the imitated line, its external counterpart. Figs 9 and 10 show the nominal and equivalent circuits of these lines. In Fig. 9, the nominal II, $A''B''$, contains an architrave impedance $2202 + j5599$ ohms, and the imitated line would con-

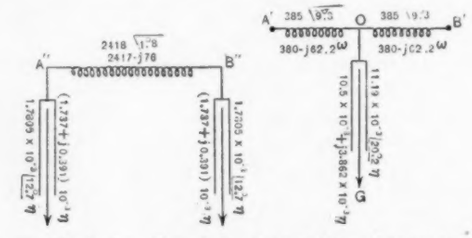


Fig. 10.—Equivalent II and T of Artificial and Imitated Lines.

tain this impedance at the testing frequency. In each of the two terminal leaks there would be 0.01391 $\angle 90°.5$ mho. corresponding to 2.913 microfarads of total distributed capacity. Similarly, the nominal T, A' B' contains in its arms a total of $2202 + j5599$ ohms, and in its single leak 0.02782 $\angle 90°.5$ mho.

Fig. 10 shows the equivalent II, $A''B''$, of three simple impedances which would externally replace either the whole artificial line, or the imitated line. The archi-

TABLE III. LINE GROUNDED AT B.

Point	Distance from B km.	Hyperbolic angle from B: $\delta = x + jy$ hyps. radians	quadrants	sinh δ	Voltage along Line: E' computed volts	E observed volts	cosh δ	Current strength along line: I' computed	I observed milliamperes	I cosh u reduced
A	800	$2.350 + j12.723$	$j8.10$	$5.20\,/9°.2$	$1.000/0°$	$1.000/0°$	$5.288/8°.8$	$2.227/12°$	$2.227/12°$	$2.227/12°$
I	760	$2.233 + j12.087$	$j7.695$				$4.710\backslash27°.1$	$1.984\backslash23°.9$	$2.454\backslash32°$	$1.995\backslash27°$
1	720	$2.115 + j11.451$	$j7.290$	$4.165\backslash64°.2$	$0.801\backslash73°.4$	$0.797\backslash84°$				
II	680	$1.998 + j10.815$	$j6.805$				$3.632\backslash108°.1$	$1.531\backslash104°.9$	$1.953\backslash114°.2$	$1.588\backslash109°.2$
2	640	$1.880 + j10.179$	$j6.480$	$3.275\backslash134°.6$	$0.630\backslash143°.8$	$0.625\backslash152°.3$				
III	600	$1.763 + j\ 9.543$	$j6.075$				$2.964\backslash173°.6$	$1.247\backslash170°.4$	$1.538\backslash180°$	$1.250\backslash175°$
3	560	$1.645 + j\ 8.906$	$j5.670$	$2.545\backslash212°.3$	$0.490\backslash221°.5$	$0.482\backslash228.2$				
IV	520	$1.528 + j\ 8.270$	$j5.265$				$2.181\backslash244°$	$0.919\backslash240°.8$	$1.150\backslash255°.7$	$0.935\backslash250°.7$
4	480	$1.410 + j\ 7.634$	$j4.860$	$2.158\backslash281°.8$	$0.415\backslash290°.7$	$0.427\backslash302°$				
V	440	$1.293 + j\ 6.998$	$j4.455$				$1.847\backslash323°.5$	$0.778\backslash320°.3$	$0.923\backslash332°.2$	$0.750\backslash327°.2$
5	400	$1.175 + j\ 6.362$	$j4.050$	$1.466/5°.4$	$0.282\backslash5°.8$	$0.286\backslash5°$				
VI	360	$1.058 + j\ 5.726$	$j3.645$				$1.525\backslash25°.9$	$0.642\backslash22°.7$	$0.780\backslash34°$	$0.634\backslash29°$
6	320	$0.940 + j\ 5.089$	$j3.240$	$1.428\backslash73°.5$	$0.275\backslash82°.7$	$0.271\backslash92°.3$				
VII	280	$0.823 + j\ 4.453$	$j2.835$				$0.955\backslash111°.4$	$0.402\backslash108°.2$	$0.510\backslash121°.2$	$0.415\backslash116°.2$
7	240	$0.705 + \ 3.817$	$j2.430$	$0.994\backslash126°.5$	$0.191\backslash135°.7$	$0.199\backslash143°$				
VIII	200	$0.588 + \ 3.181$	$j2.025$				$1.177\backslash178°.7$	$0.496\backslash175°.5$	$0.618\backslash185°$	$0.502\backslash180°$
8	160	$0.470 + j\ 2.545$	$j1.620$	$0.749\backslash237°.9$	$0.144\backslash247°.1$	$0.140\backslash253°.7$				
IX	120	$0.353 + j\ 1.909$	$j1.215$				$0.484\backslash224°.8$	$0.204\backslash221°.6$	$0.279\backslash226°$	$0.227\backslash221°$
9	80	$0.235 + j\ 1.272$	$j0.810$	$0.982\backslash274°.2$	$0.1889\backslash283°.4$	$0.1965\backslash294°$				
X	40	$0.118 + j\ 0.636$	$j0.405$				$0.813\backslash355°$	$0.342\backslash351°.8$	$0.439\backslash0°$	$0.356\backslash355°$
B	0	$0. \quad + j\ 0$	$j0$	0	0.	0.	$1.000/0°$	$0.421\backslash356°.8$	$0.439\backslash0°$	$0.439\backslash360°$

trave impedance is $2417\text{-}j76$ ohms. Each pillar leak has an admittance of $(1.737 + j\ 0.391)\ 10^{-3}$ mho. If we apply one volt to the terminal A'', then by freeing, grounding, or connecting-to-instrument the end B'', we obtain there the corresponding terminal voltages and currents observed and computed for the artificial line. That is, the current, voltage, and power will be the same at the terminals A'',B'', as at the terminals A and B respectively of the artificial line, or of the imitated smooth line, under like conditions of operation. Similarly, the equivalent T in Fig. 10, has $380 - j62.2$ ohms in each arm, and $11.19 \times 10^{-3}\ /20°.2$ mho. in its leak.

Free and Ground Impedance Tests of Artificial Line.—Table VIII collects a set of measurements on the impedance of different lengths; *i.e.*, different numbers of sections in the artificial line, commencing with one section and ending with 10 sections. Each impedance is the ratio of the terminal impressed voltage to the entering current strength. It will be seen that although the impedances, free and grounded at the far end, vary greatly as the number of sections is changed, yet their product is constant within errors of observation, and its square root, their geometric mean, is the constant surge-impedance of the line. The square root of the ratio of the two impedances also measures the tangent of the hyperbolic angle subtended by the line.

Precision of Measurements.—Owing to the great sensitiveness of vibration galvanometers, it is readily possible to measure, as above described, the potential and current along an artificial line, fairly representing 800 km. (500 miles) of aerial telephone line, without using more than 1.75 volts at the sending end per wire, or 3.5 volts per loop on the metallic circuit basis. The precision of the measurements, however, is not so great at the telephonic frequency of 760 ∼, as at the lighting frequency of 60 ∼. This relative falling off in precision may be attributed to several causes: namely, first, capacity effects in apparatus and leads not noticeable at low frequencies; second, want of practice with the technique of the method and apparatus at the higher frequency; third, stray magnetic fields in coils and galvanometer leads, a very small flux alternating at the higher frequency, and linked with the galvanometer circuit, being able to set up a very appreciable e.m.f.; fourth, irregularities in the section condensers at the higher frequency (if the condensers along the artificial line are adjusted

TABLE IV. LINE FREED AT B.

Point	Distance from B km.	Hyperbolic angle from B: $\delta = x + jy$ hyps. radians	quadrants	sinh δ	Voltage along Line: E' computed volts	E observed volts	cosh δ	Current strength along line: I' computed	I observed milliamperes	I cosh u reduced
A	800	$2.350 + j14.294$	$j9.10$	$5.288/8°.8$	$1.000/0°$	$1.000\ /0°$	$5.20/9°.2$	$2.100\ /13°$	$2.100/13°$	$2.100/13°$
I	760	$2.233 + j13.658$	$j8.695$				$4.717\backslash26°.7$	$1.905\backslash22°.9$	$2.286\backslash31°$	$1.858\backslash26°$
1	720	$2.115 + j13.022$	$j8.290$	$4.109\backslash64°.2$	$0.777\backslash73°.0$	$0.7605\backslash78°$				
II	680	$1.998 + j12.386$	$j7.805$				$3.743\backslash107°.2$	$1.512\backslash103°.4$	$1.917\backslash109°.9$	$1.559\backslash104°.9$
2	640	$1.880 + j11.750$	$j7.480$	$3.283\backslash137°.5$	$0.6209\backslash146°.3$	$0.6060\backslash151°.8$				
III	600	$1.763 + j11.114$	$j7.075$				$2.753\backslash176°.6$	$1.112\backslash172°.8$	$1.385\backslash176°.2$	$1.126\backslash171°.2$
3	560	$1.645 + j10.477$	$j6.670$	$2.609\backslash208°.9$	$0.4934\backslash217°.7$	$0.4857\backslash219°.1$				
IV	520	$1.528 + j\ 9.841$	$j6.265$				$2.380\backslash248°.5$	$0.9613\backslash244°.7$	$1.183\backslash255°.8$	$0.962\backslash260°.8$
4	480	$1.410 + j\ 9.205$	$j5.860$	$1.950\backslash285°.7$	$0.3688\backslash294°.5$	$0.3671\backslash300°.1$				
V	440	$1.293 + j\ 8.569$	$j5.455$				$1.806\backslash312°.2$	$0.7294\backslash308°.4$	$0.8943\backslash320°.0$	$0.727\backslash315°$
5	400	$1.175 + j\ 7.933$	$j5.050$	$1.773\backslash356°.3$	$0.3353\backslash5°.1$	$0.3358\backslash3°.2$				
VI	360	$1.058 + j\ 7.297$	$j4.645$				$1.370\backslash38°.0$	$0.5533\backslash34°.2$	$0.6874\backslash40°.2$	$0.559\backslash35°.2$
6	320	$0.940 + j\ 6.660$	$j4.240$	$1.129\backslash63°.0$	$0.2135\backslash71°.8$	$0.2175\backslash72°.9$				
VII	280	$0.823 + j\ 6.024$	$j3.835$				$1.247\backslash113°.2$	$0.5036\backslash109°.4$	$0.6942\backslash108°$	$0.564\backslash105°$
7	240	$0.705 + j\ 5.388$	$j3.430$	$1.088\backslash153°.4$	$0.2058\backslash162°.2$	$0.2052\backslash164°.1$				
VIII	200	$0.588 + j\ 4.752$	$j3.025$				$0.624\backslash172°.8$	$0.2520\backslash169°.0$	$0.3172\backslash177°.1$	$0.258\backslash172°.1$
8	160	$0.470 + j\ 4.116$	$j2.620$	$0.9547\backslash196°.0$	$0.1805\backslash204°.8$	$0.177\backslash203°.9$				
IX	120	$0.353 + j\ 3.480$	$j2.215$				$1.012\backslash263°.5$	$0.4088\backslash259°.7$	$0.528\backslash269°.5$	$0.429\backslash264°.5$
9	80	$0.235 + j\ 2.843$	$j1.810$	$0.3854\backslash322°.8$	$0.0729\backslash331°.6$	$0.0726\backslash331°$				
X	40	$0.118 + j\ 2.207$	$j1.405$				$0.603\backslash279°.1$	$0.2435\backslash275°.3$	$0.303\backslash282°.2$	$0.246\backslash277°.2$
B	0	$0. \quad + j\ 1.571$	$j1.000$	$1.000\backslash0°$	$0.1891\backslash8°.8$	$0.191\backslash6°.7$	0.	0.	0.	0.

TABLE V. LINE GROUNDED AT B THROUGH SUBSCRIBERS' SET.

Point	Distance from B km.	Hyperbolic angle from B: $\delta = x + jy$ hyps. radians	quadrants	sinh δ	Voltage along Line: E computed volts	E observed volts	cosh δ	Current strength along line: I' computed	I observed milliamperes	I cosh u reduced
A	800	2.393 + j14.008	j8.918	5.520/82°.2	1.000/0°	1.000/0°	5.477/81°	2.099/12°	2.099/12°	2.099/12°
I	760	2.276 + j13.372	j8.513				4.976/44°.5	1.907\24°.5	2.362\31°	1.920\26°
1	720	2.158 + j12.736	j8.108	4.272/9°.7	0.774\72°.5	0.762\78°.6				
II	680	2.041 + j12.100	j7.703				3.846\26°.5	1.474\95°.5	1.935\108°.8	1.573\103°.8
2	640	1.923 + j11.464	j7.298	3.463\64°.1	0.6274\146°.3	0.616\151°.6				
III	600	1.806 + j10.828	j6.893				2.965\99°.9	1.136\168°.9	1.427\176°.7	1.160\171°.7
3	560	1.688 + j10.191	j6.488	2.704\133°.8	0.4899\216°.0	0.483\219°.1				
IV	520	1.571 + j 9.555	j6.083				2.469\171°.7	0.9462\240°.7	1.218\254.6°	0.990\249°.6
4	480	1.453 + j 8.919	j5.678	2.077\211°	0.382\293°.4	0.379\301°.8				
V	440	1.336 + j 8.283	j5.273				1.837\243°.5	0.704\312°.5	0.851\320°.7	0.692\315°.7
5	400	1.218 + j 7.647	j4.868	1.826\280°.6	0.3308\2°.8	0.334\1°				
VI	360	1.101 + j 7.011	j4.463				1.534\324°.9	0.5879\33°.9	0.7386\40°.1	0.601\35°.1
6	320	0.983 + j 6.374	j4.058	1.152\253°.5	0.2087\75°.7	0.2071\78°.1				
VII	280	0.866 + j 5.738	j3.653				1.299\27°.9	0.4978\96°.9	0.6602\103°.5	0.537\98°.5
7	240	0.748 + j 5.102	j3.248	1.236\75°.1	0.2239\157°.3	0.2295\159°.8				
III	200	0.631 + j 4.436	j2.843				0.718\113°.8	0.2752\182°.8	0.3481\188°.2	0.283\183°.2
8	160	0.513 + j 3.830	j2.438	0.834\119°.4	0.1511\201°.6	0.1537\199°				
IX	120	0.396 + j 3.194	j2.033				1.078\178°.7	0.4131\247°.7	0.5548\258°	0.443\253°
9	80	0.278 + j 2.557	j1.628	0.631\243°.3	0.1143\325°.5	0.1115\333°				
X	40	0.161 + j 1.921	j1.223				0.369\204°.8	0.1414\273°.8	0.1868\274°.3	0.152\269.3°
B	0	0.043 + j 1.285	j0.818	0.979\275°.3	0.1773\357°.5	0.1828\352°	0.293/8°	0.1123\61°	0.115\62°	0.115\62°

TABLE VI.

	Resistance at 20° cent. ohms	Inductance henrys	Capacitance microfarads	Leakance micromhos	Hyperbolic Angle θ hyps. /	Surge Impedance z_0 ohms	Remarks
Line (800 km.)...	2205	1.173	5.823	0	12.94 /79°.5 = 2.35 + j12.72 = 2.35 + j 8.10	465 \11°	The imitated line corresponds approximately to one of a pair of No. 9 A. W. G. copper wires, diameter 2.9 mm. 0.114" separated in air to a distance of 1000 diameters or 2.9 meters.
Per wire-km.....	2.756	1,463 × 10⁻³	7.28 × 10⁻³	0	0.01618 /70°.5 = 0.00294 + j0.0159 = 0.00294 + j0.0101	465 \11°	
Per loop-km.....	5.512	2.926 × 10⁻³	3.64 × 10⁻³	0	"	930 \11°	Underscored imaginary quantities are in quadrant measure.
Per wire-mile....	4.44	2.35 × 10⁻³	11.72 × 10⁻³	0	0.02604 /79°.5 = 0.00473 + j0.0256 = 0.00473 + j0.0163	465 \11°	
Per loop-mile....	8.88	4.70 × 10⁻³	5.86 × 10⁻³	0		930 \11°	

TABLE VII.

Angle θ hyps. /	Surge impedance z_0 ohms /	sinh θ	tanh $\theta/2$	Semi-section angle u	Correcting factors: cosh u	$\frac{\sinh\theta}{\theta}$	$\frac{\tanh(\theta/2)}{\theta/2}$
12.94/79°.5 = 2.35 + j12.72 = 2.35 + j 8.10	465 \11°	5.2 /9°.2	0.8277 /1°.7	0.647 /79°.5 0.1175 + j0.636 0.1175 + j0.405	0.813/5°	0.4018 \70°.3	0.1279 \77°.8

Equivalent Π

Architrave impedance $z_0 \sinh\theta$ = 2418 \1.8° ohms.
= 2417 − j76 ohms.

Pillar leak admittance $1/\{z_0 \tanh(\theta/2)\}$ = 1.78 × 10⁻³ /12°.7

Equivalent T

Arm impedance $z_0 \tanh(\theta/2)$ = 385 \9.3° ohms.
= 380 − j62.2 ohms.

Staff leak admittance $1/(z_0 \sinh\theta)$ = 11.19 × 10⁻³ /20°.2 mho.
= (10.5 + j3.862) 10⁻³ mho.

to equality at a low frequency they may readily show differences as well as diminutions in capacity at the higher frequency); fifth, deviation of the wave form of impressed e.m.f. from the sinusoidal, or the presence of harmonics. This affects the split-phase balance, and phase measurements. The vibration galvanometer may be broadly considered as responding only to the fundamental frequency, the harmonics being independent of it, and unable to affect it. Nevertheless, the presence of the harmonics is able to produce some disturbance of the zero, and thus may have some small influence on the measurements.

By practice, and with further experience, some of the above-mentioned disturbing sources may be reduced, and the precision of measurement increased. Nevertheless, the precision attained in the results here reported

TABLE VIII.

No. of sections	Impedance: Grounded Z_g ohms ∠	Impedance: Freed Z_f ohms ∠	$Z_g Z_f$ ohm² ∠	Surge impedance $Z_o = \sqrt{Z_g Z_f}$ ohms ∠	$\tanh \theta = \sqrt{Z_g / Z_f}$	θ	$2u$ mean section angle
1	1244/38°.4	167\36°	208300\17°.6	456.4\8°.8	2.725 /47°.2	0.246 + j1.342	0.246 + j1.342
2	346.4\47°.3	623.8/28°.2	216100\19°.1	464.9\9°.55	0.7452\37°.75	0.497 + j2.583	0.249 + j1.292
3	441.3/14°.1	497.8\36°.3	219700\22°.2	468.7\11°.1	0.9415/25°.2	0.747 + j3.855	0.249 + j1.285
4	588\2°.6	337.5\16°.6	198470\19°.2	445.5\9°.6	1.320 /7°.0	0.940 + j4.510	0.235 + j1.128
5	387.7\10°.6	576.1\13°.5	223400\24°.1	472.7\12°.05	0.8203/1°.45	1.157 + j6.346	0.231 + j1.269
10	449.0\12°.0	476.2\13°	213800\25°	462.4\12°.5	0.9712/0°.5	2.35 + j12.72	0.235 + j1.272
			Accepted mean values	465.\11°			0.235 + j1.272

will doubtless be considered as satisfactorily sustaining the theory of such telephone-line transmission, at a single telephonic frequency, in the steady state. A great variety of telephonic tests and measurements can be made on such an artificial line under different terminal conditions, and with different receiving instruments. Such an artificial telephone line has great practical value for the telephone engineer, the investigator and the student.

The Lay of a Layman

By the T. E. Dopester

THERE is a telephone exchange in the average town. Connecting with this telephone exchange is an office and with the office an executive who is dignified with the title of business manager. It would be an exception to the rule if this individual did not feel that he was some pumpkins in his community. He is known among the substantial sort who rally to the call of civic duty. He signs the subscription paper for the annual W. C. T. U. picnic and contributes towards the funds to sprinkle Main street and defray the incidental expenses of the regular band concert Saturday nights. He is known at the bank and his credit is good with the butcher. When a salesman for a telephone company comes to town, this b. m. gets a special dispensation from the Missus and takes his luncheon at the hotel where it is charged up to the house who sent the salesman out on the road to get orders. At this luncheon there is much shop-talk confined to the local condition. The salesman butts-in with his set speeches about this and that improvement in equipment. The business manager doesn't seem to be interested. Those things are usually passed upon by the board of directors whose chief function is to meet once a year—usually about Christmas—and split up the profits. When the plant is worn out, they will consider buying a new one, consuming six months of time and other liquids and condiments. The business manager exults because he has got through for twelve months on less money than the year before. No wind storm swept away his leads and no sleet storm played havoc with his wires and insulators. Lightning was kind to him—he escaped it entirely. With this splendid record he feels sure he will be remembered with an increase in salary—say possibly as much as five dollars a month. He will have no extravagant recommendations. The business will wag along on the old basis and he will be happy.

* * *

I am talking about the telephone business of the average town. The only thing that might jar the peaceful tenor of it would be to discharge a barrel of powder under the central office. It has been that way ever since the excitement of building the system subsided. And that is what ails the telephone business in the average town.

* * *

In the beginning there was ambition to reach out for more territory. Today everybody is willing to let well enough alone. It applies universally.

* * *

The average business manager of the system in the average town has more interest in the baseball score of his pet team than he has in maintenance of plant. He knows every subscriber by his first name. He doesn't worry about collections. Being familiar with every kink in his own equipment, he isn't concerned about new things. He can't have them, anyway. His morning mail isn't heavy. There are three postal cards, two circulars and one invoice. He files the latter on a bill hook for the flies to roost on. The rest of the stuff goes into the waste paper basket. If by chance a sample copy of a trade paper blows in, he takes it home for the baby to play with. Trade journals are filled with vague technicalities that were not meant to interest him. He has served his apprenticeship and taken a post-graduate course with the system that supports him. He knows everything telephonic there is to know. When a requisition for another subscriber comes in, it comes from a neighbor's telephone. The order is telephoned in. If there is enough stuff in the warehouse, the instrument is cut in on the party line circuit already burdened with stations. If the warehouse is empty the order hangs fire till somebody discontinues the service. Ten to one it is a rummy old set that should have been thrown out years before, but it works and pride is not considered in the balance sheets. This isn't an idle dream. It is the adopted rule of the average manager of the telephone exchange in the average town. There are thousands and thousands of him. In his community he is a good fellow, but he isn't a live wire from

the manufacturer's or the publisher's point of view. The publisher would like to have him wake up to the importance of subscribing for his trade journal. The manufacturer would like to have him show progress. It would help the game all around.

* * *

What this business needs is fifty thousand new telephone managers of telephone systems—men who will apply modern methods of business getting. It is bad practice to wear out the patience of the public by attempts to serve with obsolete apparatus.

* * *

All over this country people use telephones. They are fondly addicted to cursing the system, no matter who made it. It is loggy in hot weather and confused with crosses in cold weather. There is always something wrong with the system we are using. If you ask the man who wails the longest and the loudest he can never recall the time when a repair man invaded the sanctity of his place of business. If he doesn't unscrew the mouth piece of his transmitter and give it an occasional bath it shows it. And most of them show it! The nickeled parts are no longer bright and the receiver has turned a dull brown. No marks of the screw-driver or a wrench are visible. It has been several years since it fell off the desk and was picked up unscathed. There is little excuse for the repairman on inside installation. The records at central office, where they sometimes indulge in such extravagance, betray no time spent on the circuit. The switchboard shows corrosion in spots, but it goes right along responding to the operators' requirements. Time will wear it away, but it takes lots of time. Everything works, including the impatience of the subscriber.

* * *

All of which emphasizes that telephone equipment is mighty good stuff. It resists innovations. We adhere to the present types of subscribers' stations because the tools responsible for making them have their well worn places in manufacturers' vaults. We maintain the present style because we have to. It would be suicide to scrap such good instruments! The big city terminals of railroads are not electrified because a tolerant public does not insist upon it. Our desks are cluttered up with flexible cords and all sorts of contraptions to hold a desk set of the conventional type, because it would cost too much money to substitute those dainty little hand michophones that would hang out of sight. Fashion decrees nothing new in telephones. Improvement is stifled because the old stuff answers every need. The factory depends upon replacements wrought by an act of God and the extension of plant that an ever increasing population forces. If it is an ambitious factory, it invades the foreign market, not with the newer stuff, especially, because the old has proven its efficiency and is easier to place. And what factory of importance hasn't developed new stuff?

* * *

A few years ago, one of the substantial concerns—a pioneer in the independent field—shocked the trade by sweeping out all of the old line and announced simultaneously that it would make and sell an entirely new line of apparatus. The judgment of such extrordinary procedure is not being questioned today. The precedent thus estabished has been adopted by at least one other of the earlier makers of telephone equipment.

* * *

Nearly two years have elapsed since the largest telephone manufacturer in the world attempted to corral all the basic patents for a system that had proven a distinct advance in the art of telephone operation. It succeeded in satisfying itself to a great extent. That same manufacturer has shown no outward evidences that it will ever use these patents acquired at tremendous cost. To a man up a tree it merely sought protection to serve the public in the old-fashioned way. If there was another motive it fails to appear.

* * *

For the really new improvements, foreign countries seem to afford the best outlet. The abominable systems have been perpetuated until the public patience ceased to endure. The evolution of ownership has lodged with the governments themselves and this expedient has failed to satisfy. Unless some better way is provided our own people may be foolish enough to take hold. There is no good reason why a telephone system must be worn completely out before improvement shall be considered. We would have a fine state of affairs if railroads were operated on similar lines. Fancy the scrapping of the New York Central lines for something new!

* * *

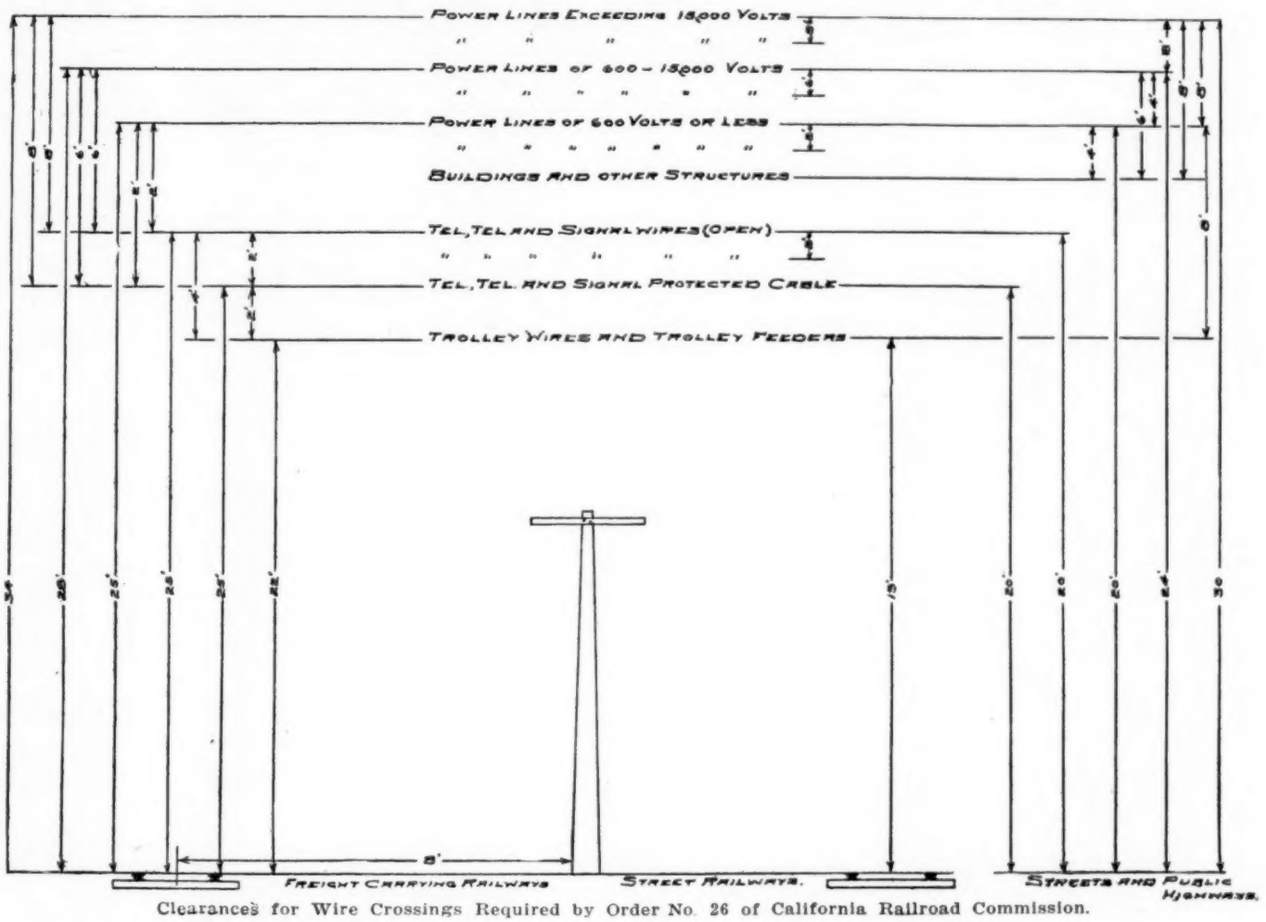
There are two telephone operating factions—the Bell and the independents. If there has been anything new in the line of Bell equipment in the several years past, we fail to find it. There have been small refinements which tend towards greater economy in manufacture, but that is about all. The unit-type switchboard suggested itself because of economy all around. The scheme is to make standard stuff in large quantity and at a low price with satisfactory margin of profit. This custom has been followed largely by the independent manufacturer because his field is smaller and his output correspondingly limited. But we are safely within the truth when we say that the independent manufacturer is responsible for the greater amount of improvement. He is always devising a better operating plan—a system that will render more efficient service to the subscriber. He drives it into the heads of the average business manager that these new things can be applied right now, before the plant shall be scrapped. The replacement of old types of apparatus will stock up the storeroom for emergencies. By the hardest kind of salesmanship there is created a small demand and the proven worth of the new apparatus creates more orders. But it is never adequate for all the effort it has taken. The average telephone exchange manager is too easily pleased.

The Russian government maintains ninety-nine telephone lines, the length of which at the conclusion of the year 1909 was 7,749 versts, or 5,200 miles. The wire measured 86,091 versts, or 57,680 miles, and the area covered was 6,280 square miles, with a population of 2,500,000. The 415 miles between St. Petersburg and Moscow is covered by the principal line. Twenty-seven per cent. of the capital invested was the profit which amounted to $61,912, the gross profit being $86,684 and the expenses $24,772. In the principal towns in the empire are a number of private telephone companies, their lines being 1,760 miles in length and 191,000 miles of wire being used. In addition, there are 529 local lines in towns, twenty-eight lines connecting different towns and 133 government and district lines. The total miles of line represented is 26,758 and of wire, 500,040. There are 10,729 stations and 31,064 instruments.

Oregon Regulations on Line Construction

State Commission's Rules

THE Railroad Commission of Oregon has prepared tentative general regulations governing overhead and underground construction of telegraph, telephone, signal, trolley and power lines throughout the state. These regulations apply to new construction in Oregon and are not to be construed as limiting the right of the commission to change any installation that is believed to be hazardous. It is not intended, by these general regulations, to supersede any local municipal regulations or ordinances.



Clearances for Wire Crossings Required by Order No. 26 of California Railroad Commission.

OVERHEAD CLEARANCE.

1. Railroads and Street Railroads.—a. When telegraph, telephone or signal lines, or power lines of not exceeding 600 volts, cross above railroads or street railroads, a minimum clearance of 25 feet shall be provided, except that the clearance above trolley wires and trolley feeders hereinafter specified (Section 1-*c*) shall in all cases be observed.

b. When power lines, other than trolley wires and trolley feeders, which transmit power at from 600 to 15,000 volts, cross above railroads or street railroads, the minimum clearance shall be 28 feet. When such lines transmit power in excess of 15,000 volts the minimum clearance shall be 34 feet.

c. When trolley wires or trolley feeders cross above railroads or street railroads, a minimum overhead clearance shall be provided of 23 feet, or otherwise as specified in Section 5 of this order.

2. Streets and Public Highways.—Telegraph, telephone and signal lines, and power lines of not exceeding 600 volts, which cross above streets or public highways, shall have a minimum overhead clearance above the surface thereof of 20 feet; power lines of from 600 to 15,000 volts, 24 feet; power lines of above 15,000 volts, 30 feet; and trolley wires and trolley feeders, 19 feet. The minimum clearance for such lines, above railroads and street railroads which occupy streets and public highways, hereinbefore specified in Section 1, shall in all cases be observed.

3. Telegraph, Telephone and Signal Lines.—Telegraph, telephone and signal lines, crossings with telegraph, telephone or signal lines of other companies, shall have a minimum clearance, above or below such lines, of 2 feet, unless suitably supported to prevent contact; above

trolley wires or trolley feeders, 4 feet, except for properly protected cables, when 2 feet will be permitted; blow power lines of 600 volts or less, 2 feet; below power lines of from 600 to 5,000 volts, 4 feet; below power lines from 5,000 to 15,000 volts, 6 feet, and below power lines of exceeding 15,000 volts, 8 feet.

4. Power Lines—Other than Trolley Wires and Trolley Feeders.—a. Power lines, other than trolley wires and trolley feeders, of not exceeding 600 volts, shall have a minimum clearance above rails at crossings with railroads and street railroads of 25 feet; above streets and public highways, 20 feet; above telegraph, telephone and signal lines, 2 feet; above or below other power lines or not exceeding 600 volts, unless suitably supported to prevent contact, 2 feet; above all trolley wires and trolley feeders, 4 feet; above or below other power lines of from 600 to 5,000 volts, 4 feet; below other power lines of from 5,000 to 15,000 volts, 4 feet; below other power lines of exceeding 15,000 volts, 8 feet; and above all buildings and structures, 4 feet.

6. Power lines, other than trolley wires and feeders of from 600 to 15,000 volts shall have a minimum clearance above rails at crossing with railroads and street railroads, of 28 feet; above streets and public highways 24 feet; above telegraph, telephone and signal lines, for power lines of from 5,000 down to 600 volts, 4 feet, and for power lines of from 5,000 to 15,000 volts, 6 feet; above or below other power lines of not exceeding 600 volts, 4 feet; above or below other power lines of from 600 to 15,000 volts, 6 feet; below other power lines of exceeding 15,000 volts, 8 feet; and above all buildings and structures, 6 feet.

c. Power lines of exceeding 15,000 volts shall have a minimum clearance above rails at crossings with railroads and street railroads of 34 feet; above streets and public highways, 30 feet; above telegraph, telephone and signal lines, 8 feet; above other power lines of not exceeding 15,000 volts, 8 feet; above or below other power lines of exceeding 15,000 volts, 8 feet; and above all buildings and structures, 8 feet.

5. Trolley Wires and Trolley Feeders.—Trolley wires and trolley feeders or railroads, and street railroads which transport or propose to transport standard freight cars, shall have a minimum clearance above their own rails of 23 feet, and of other street railroads, 19 feet, provided, that when street railroads which do not transport or propose to transport standard freight cars are on streets or public highways which cross under other railroads, such minimum clearance of the trolley wire above rails shall be 13 feet and 6 inches. Such trolley wires and trolley feeders shall have a minimum clearance at crossings above the rails of other railroads and street railroads which transport or propose to transport standard freight cars, of 23 feet; and above other street railroads, 19 feet. Trolley wires and trolley feeders shall have minimum clearance below telegraph, telephone, signal and power lines as hereinbefore provided.

6. All power lines transmitting power at 15,000 volts and in excess thereof, and which cross over railroads, street railroads, telegraph, telephone, signal and other power lines, shall be constructed to conform to the "Specifications for Overhead Crossings of Electric Light & Power Lines" adopted at the present time by the joint committee of the National Electric Light Association, the Association of Railway Telegraph Superintendents, and the American Railway Engineering and Maintenance of Way Association, in so far as the same are not in conflict with any of the provisions of the law of the state of Oregon, and except further that the clearance hereinbefore provided in this order, together with the restrictions thereon, shall be observed.

Note 1. It will be understood that this commission adopts the specifications at present issued by the joint committee above named and any change, modification or alteration in same which may hereafter be issued or adopted by said joint committee will not be applicable to the matters contained in this order until submitted to and approved in formal order by this commission.

Note 2. As an alternative for the construction prescribed in the above specifications, pole of such length may be used for the crossing spans that a wire breaking at any point in the crossing span will swing clear of the wire leads below. As a further alternative, conditions permitting, when such power lines cross telegraph or telephone lines, the latter may be placed underground at the crossing span.

Note 3. As an alternative, conditions permitting, telegraph and telephone lines and power lines of less than 600 volts may be placed underground wherever they cross railroads or street railroads.

Note 4. The minimum clearance for wire lines hereinbefore provided shall have reference to clearances which will obtain under the most unfavorable conditions of temperature and loading in the district concerned, provided that the prescribed factors of safety are observed.

CONSTRUCTION.

7a.—The minimum size of wire to be used where power lines cross above railroads or street railroads, telephone, telegraph or power lines shall be as specified or their equivalent in strength.

For power lines other than trolley wires and feeders of less than 600 volts—No. 10 B. & S. G. copper.

For power lines of more than 600 volts and less than 5,000 volts—No. 6 B. & S. G. copper.

For power lines of over 500 volts, series or constant current circuits excepted—No. 4 B. & S. G. copper.

7b.—At crossings as specified under *7a* where wooden poles are used, the maximum length of span for wires carrying voltages above 600 shall be 150 feet, and only the best selected poles of a minimum diameter of 7 inches shall be used.

8a.—When more than one cross arm is mounted on a pole, no cross arm supporting a wire or cable carrying a voltage in excess of 600 shall be placed within a distance less than 4 feet, measured center to center, from any other cross arm supporting a wire or cable carrying a voltage of less than 600.

8b.—No wire or cable carrying a voltage in excess of 600 shall be placed within a distance less than 14 inches, measured from center to center of insulator, from any other wire or cable on the same cross arm, provided that this minimum spacing shall not apply to wires of the same potential.

8c.—No wire or cable shall be placed on any pole support within a distance of 15 inches from the center line of said pole, provided that telephone, telegraph and signal wires may be placed within a distance of 15 inches; and provided that this rule will not apply to wires or cables run vertically from underground, or to wires run from circuit wires to lamps or transformers supported on the same pole, or to telephone cables supported by messenger cables.

9.—No guy wire or guy cable attached to any pole or appliance to which is attached any wire or cable used to conduct or carry electricity shall be placed without causing said guy wire or guy cable to be effectively insulated at all times at a distance of not less than 4 feet nor more than 8 feet (measured along the line of said wire or cable) from the upper end thereof and at a point not less than 8 feet vertically above the ground from the lower end thereof; provided that no insulation shall be required at the lower end of a guy wire of cable where

the same is attached to a grounded anchor. This regulation shall not apply to guy wires or cables attached to poles carrying telegraph, telephone or signal wires and cables, or to power wires or cables carrying a voltage of less than 600, and which are situated outside the corporate limits of any town or city.

10.—Fixtures placed or erected for the support of wires on the roofs of buildings shall be of sufficient strength to withstand all strains to which they may be subjected, due to the breaking of all wires on one side thereof, and, except where insulated wires or cables are held close to fire walls by straps or rings, shall be at such a height as to give the clearances herein specified for structures, and any wire or cable carrying a voltage in excess of 600 shall be marked with the word "Danger" in letters at least 3 inches high on the supporting structure and at all other points where there is a hazard.

11.—In all cases where wires which are conductors of electricity are strung above or below lines which are used to carry electricity in excess of 600 volts, suitable appliances shall be furnished the workmen to guard against accidents, *e. g.*, drag ropes, insulated clamps, insulated loops and other appliances which will prevent contact with the wires carrying electricity in excess of

12.—When lines of 600 volts or over are cut out at station or substation to allow employes to work upon them, they shall be short-circuited and grounded at the station, and shall, in addition, if the line wires be bare, be short-circuited, and when possible grounded at the place where the work is being done.

LOCATION.

13a.—Telephone and telegraph lines, and telephone and power "drops" or "service wires" must be placed below power wires carrying 600 volts or over at the clearances hereinbefore specified. Where it may be shown to be impracticable to string telephone and telegraph wires below power wires which are used to carry in excess of 600 volts, the telephone or telegraph line must employ the same mechanical strength of construction as would be required in case said power lines were constructed over the telegraph, telephone and signal lines.

13b.—Power lines of more than 600 volts shall be constructed along one side of any public highway and telegraph, telephone and signal lines shall be constructed on the opposite side of said public highway unless it is shown to be impracticable.

13c.—No company shall construct a pole line which will parallel "overbuild" or "underbuild" any existing pole line without first giving such other company reasonable notice in writing of its intention to do so, provided that this provision shall not apply to wires crossing over or under existing wires at an angle.

GENERAL.

14.—The neutral point or wire of all transformer secondaries strung or erected for use in low potential distributing system shall be grounded in all cases where the normal maximum difference of potential between the ground and any point in the secondary circuit will not exceed one hundred and fifty volts. When no neutral point or wire is accessible, one side of the secondary circuit shall be grounded in the case of single-phase transformers, and any one common point in case of interconnected polyphase bank or banks of transformers. Where the maximum difference of potential between the ground and any point in the secondary circuit will, when grounded, exceed one hundred fifty volts, grounding shall be permitted. Such grounding shall be made by connecting a wire or wires not less than No. 6 B. & S. gauge to: (*a*) A water pipe of a metallic system; (*b*) A copper plate 1/16 inches thick and not less than 3 feet by 6 feet area buried in coke below the permanent moisture level; (*c*) Other device equally as efficient.

15.—Transformers, either single or in bank, that exceed a total capacity of ten kw. shall be supported by a double cross-arm or some fixture equally as strong. No transformer shall be placed on any cross-arm or other appliance on a pole upon which is placed a series electric lamp.

16.—Any change in the characteristics of a line which carries or is to carry voltage in excess of 5,000 shall be reported to the commission.

17.—As between any two wires or cables carrying different voltages mentioned in these rules, only the wires or cables so placed last in point of time shall be held in violation thereof.

UNDERGROUND.

18.—No manhole containing any wire carrying a current of over 300 volts shall be less than 6 feet from floor to inside of roof; if circular in shape it shall be 6 feet from wall to wall; provided, however, that this paragraph shall not apply to any manhole in which it shall not be required that any person enter to perform work; provided further, that the foregoing provisions of this paragraph shall not apply where satisfactory proof shall be submitted to the proper authorities that it is impracticable or physically impossible to comply with the law within the space or location designated by the proper authorities.

19.—All manholes containing any wires or appliances carrying electrical current shall be kept in a sanitary condition, free from stagnant water or seepage or other drainage which is offensive or dangerous to health, either by sewer connection or otherwise, while any person is working in same.

20.—No manhole shall have an opening to the outer air of less than 26 inches in diameter, and the cover of same shall be provided with vent hole or holes equivalent to three square inches in area.

21.—No manhole shall have an opening which is, at the surface of the ground, within a distance of 3 feet at any point from any railway or street car track; provided, that this shall not apply where satisfactory proof shall be submitted to the proper authorities that it is impracticable or physically impossible to comply with the provisions of this paragraph; provided, that in complying with the provisions of this rule only the construction last in point of time performed, placed or erected shall be held to be in violation thereof.

22.—Whenever persons are working in any manhole whose opening to the outer air is less than three feet from the rail of any railway or street car track, a watchman or attendant shall be stationed on the surface at the entrance of such manhole at all times while work is being performed therein.

23.—There shall be provided cutout switches on all primary and secondary wires in all manholes where the wires are connected with transformers or other electrical devices therein.

24.—All persons employed in manholes shall be furnished with insulated platform so as to protect the workmen while at work in the manhole; provided, that this paragraph shall not apply to manholes containing only telephone, telegraph or signal wires or cables.

Novel Uses of Telephones

Novel uses to which the telephone has been put were described at a Western Electric conference of telephone salesmen by W. D. Lindsay, secretary of the convention.

A new field in which the telephone is going to play a prominent part, is that of cost keeping. The first system of this kind has been installed in Chicago by Marshall Field & Company in the garment repair department. Every job is numbered, but the workman does not pay any attention to keeping a time record. He telephones the time of starting and finishing a job to the bookkeeper from a telephone on his bench. This system will soon be in use in many factories.

An automatic telephone temperature recorder has been placed in an Idaho fruit orchard. Lines radiate in all directions from a central office and connect with thermometers. When the temperature falls below a certain point, the operator at central is notified automatically, and she arouses the farm hands, who go out with their smudge pots to protect the crop from being frozen.

Divers, working in groups of two and three, may now talk to each other and to men stationed above the water by means of improved telephone systems. The "Chau-phone" is now installed in limousine automobiles, so that persons sitting in the rear of the car may talk with the chauffeur. Portable telephones are carried by foresters, who spread the word of forest fires and other dangers.

A special device has been perfected for making rescues in mines. In order that the rescuer may breathe freely, the transmitter is placed on his throat below the chin. He carries coils of wire so that he may go for miles into the recesses of a mine.

It is not probable that the telephone will be used on moving trains or ships. The wireless system has been experimented with for years, but no satisfactory results have been achieved. The difficulty with wireless telephony is greater than with wireless telegraphy. In the former a continuous sound wave must be sustained, and this cannot be done where the distance varies.

A buzzing sound is heard which shuts off the sound of the voice. Another objection is the necessity of having a large power station. Then, too, it is necessary to have the two stations tuned to the same pitch. If all the stations were tuned the same, messages could be heard in any station and nothing at all could be understood. The initial expense of installing two wireless stations for telephone purposes is $1,000. While this kind of sound transmission is possible, it is not commercial.

Michigan Commission News

As a result of an opinion rendered by the Michigan Railroad Commission, in which it is pointed out that it is discrimination for a telephone company to give a lower rate to the state, county or municipality than is given to the private subscriber, city, county and state telephone rentals will probably be increased. At present the state is paying $20 per year for its telephone service in Lansing, while local business houses and private subscribers pay a much higher rate. An act passed by the legislature of 1911 prevents discrimination of this sort and in all probability when the contracts are made for next year the rates will be the same.

In the case of a Mt. Pleasant physician, who complained to the commission that he had a Citizens' telephone in his office and another instrument in his residence, and who declared he should be charged an extension rate for the house telephone, the commission held it is not justifiable to charge extension rates where the second instrument is not located on the premises of the main telephone.

The commission also held the use of a telephone and not its location should govern its classification as to rates. If a subscriber has a telephone in the dining room of his house and conducts a grocery store in the front room, the board holds he must pay a business rate for the telephone in his dining room if he uses it to conduct his grocery business.

Australian Telephones

The telephone systems throughout the Australian commonwealth are administered by the postal department. The extension of the telephone service in Australia is making rapid progress by direct lines and through the adaptation of telegraph wires for telephonic purposes by means of the condenser. The government is spending large amounts from year to year in new equipment and the construction of lines. At the end of 1911, there were throughout the commonwealth 85,458 telephone lines connected to 927 exchanges. The number of instruments connected was 102,654, giving 2.25 per cent of instruments to the population.

The cost of the instruments installed and the connections made are (unless in exceptional circumstances) defrayed by the postmaster general's department. Formerly a specific rate was charged for the hire and connection of a telephone which entitled any subscriber to an unlimited number of calls. In recent years the annual charge was reduced (in some of the states by over 50 per cent) and a further charge is now made for each effective call. Immediately the annual subscription was reduced the demand for telephones—especially for private houses—increased to such an extent that the department was unable to cope with the requirements. The charges for a telephone connection throughout Australia are as follows:

Population	Radius with main exchange miles	Minimum Annual Charge: For an exclusive service	Two party service	Three or more party service
From 1 to 10,000	5	$15.00	$12.50	$10.00
From 10,001 to 100,000	10	17.50	13.75	11.25
From 100,001 upwards	10	20.00	15.00	12.50

For all effective calls, subscribers are charged the following additional rates:

For calls not exceeding 2,000 half-yearly one cent each.

For calls above 2,000 half-yearly, three calls for two cents.

No charge will be made to the subscriber for calls received by him.

Music Given by Telephone

Music by telephone is the latest novelty in Memphis, Tenn.

The Memphis Telephone Company has installed an arrangement whereby latest rag numbers are heard in cafes and other public places by use of the telephone system.

The telephone of each subscriber to the service is connected with an electrically driven phonograph in the telephone building and the tones from the instrument are reproduced by a high power telephone receiver.

"The plan is rather new," said Robert H. Polk, general manager of the company. "This system is the third to be installed. Others are operating at Chicago and at Wilmington, Del."

European Telephone Development

By Fred W. Scholz

SUGGESTIONS FOR IMPROVING MANUAL TELEPHONE SERVICE

AT a joint meeting of the English and French telephone engineers in Paris this last spring, suggestions were made to improve the service of manual telephone service, which are given in abstract in the following paragraphs. These suggestions may be roughly divided into three parts, namely: 1. Devices to distribute calls equally among all the operators; 2. Devices to improve traffic service on B-operators places, where more than one inter-exchange trunk line ends; 3. Devices for selecting and using outgoing trunk wires in cases where several trunk lines are used to operate a large number of service wires belonging to subscribers.

Call Distributer.—Under ordinary circumstances service is arranged in such a way that there is some rest time for operators between different calls, so that they shall have a little time to recuperate between a large number of successive calls, especially at rush hours. The question was to devise some sort of arrangement that would automatically select a free operator at the exchange when the subscriber removed his receiver. This would equalize the service on the exchange side and would give a more even efficiency factor than has been obtained so far. The apparatus, which is to be tested out in a short time in a London exchange, is going to have 10 to 20 lamps attached to the call distributer instead of using individual calling or answering keys. Every operator can only receive one call at a time; in other words, while she is busy with the one call only one lamp can light up at her board. All other calls are distrbuted to other operators' places. As this distributer is likely to go out of order some time or other, and leave lamps lighted for a length of time, every operator's board is connected to a trouble operator's switchboard, who can connect with any operator and determine what lines are faulty and need repairs.

B-operators for several exchanges.—Several cities have complained that there is much delay and confusion since several trunk lines ended at one B-operator's switchboard. A device is under way which is to select automatically so that only one A-operator can call up the common B-operator at any given time. The B-operator is to be permitted to use her wires in such a manner that only one call can pass through her trunk lines from any outside exchange and that any of the other exchanges, calling this same B-operator, will have to wait until the B-operator is free to answer their calls. A lamp is to notify the B-operator that her trunk lines are wanted. This system is supposed to reduce the number of wrong numbers given, and to increase speed of service.

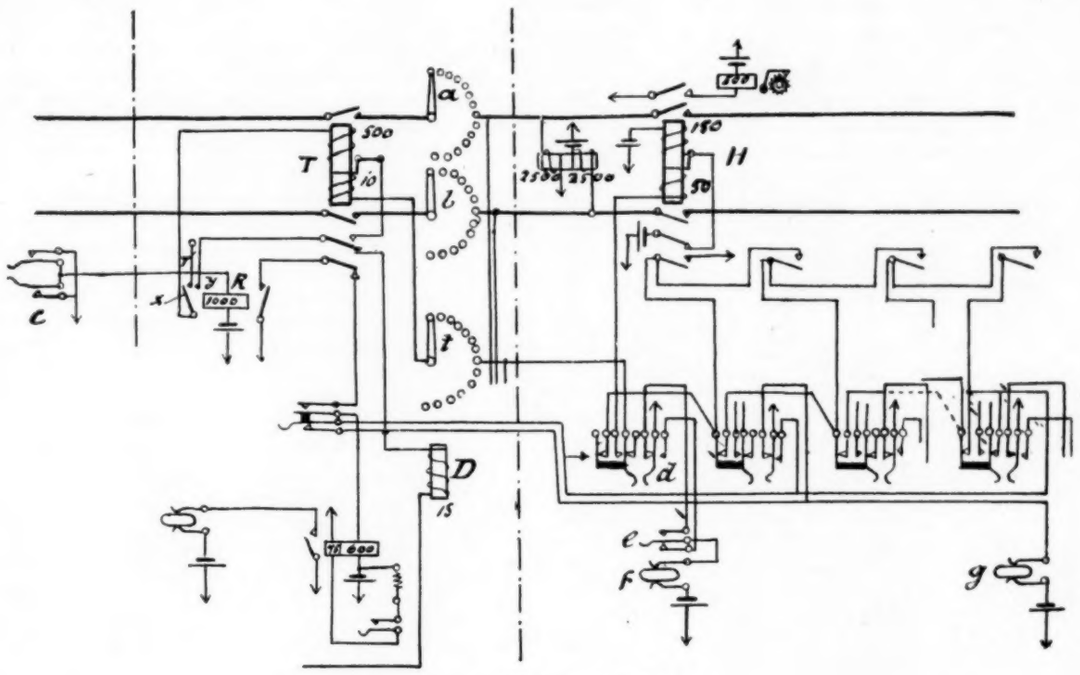


Fig. 1.—Automatic Trunk Line Selector.

Trunk Line Selectors.—Service between busy exchanges has been very unsatisfactory in late years due to the fact that with common use of trunk lines one A-operator would interrupt another A-operator in the desire to bring her calls through first, and in that A-operators often found the common trunk lines to be used for a great length of time by other A-operators. The London exchange has instituted a new system which selects an open trunk line for the A-operator and assures her the use of this line as long as she needs it. The group in question has ten trunk lines for inter-exchange work, which by a multiple switch board system can be connected to at least 160 operators' places. With the new device one key per operator was substituted for

the ten trunk connections. Every operator has one selector, which rotates as soon as she presses down her key. The rotation goes on, until the selector has found a B-operator when the A-operator gives her call number and gets connections. Only one A-operator can be connected with any B-operator at the same time. At the moment when the connection is made a clicking in the receiver announces that fact to the A-operator. If all B-operators are busy, a red lamp lights up at the B-switchboard and the night bell rings. Every B-operator's switchboard can be shut off from any A-operator by laying over a key. This is done when the B-switchboard is through with the day's work, or when all lines at the B-board are busy. At a supervisor's table a red lamp lights up when all B-operators are used at the same time by A-operators. A long extended glowing of this lamp shows that the A-operators cannot receive connections with B-operators, that there is a delay in the service and that more B-operators are needed. The details of the device are shown in the illustration.

Every A-operator has a selector, and every selector is connected to two relays *R* and *T*. The different contacts of the selectors are interconnected in multiple arrangement and are connected to their proper group of B-places, so that every B-operator's board at every set of contacts has a corresponding set of contacts in the selectors. At every B-board is a relay *H*, and a choke coil. The *a* and *b* arms of the selector are connected with the telephone circuit of the B-operator by means of contacts of the relay *H*. When the trunk line key *c* is pressed down by an A-operator, the arms of her selector begin to run along the contact sets and remain stationary at the moment when they have found an open B-operator. The relay *T* of the A-operator and the relay *H* of the selected operator, operate so that the two telephone circuits are connected to the ends of the trunk lines. If the trunk line key is released the selector arms remain stationary. The relays *T* and *H*, however, disconnect the telephone circuits of the A- and B-operator from the trunk lines. As long as the trunk line is in use the relay *T* is in action, the voltage in the *t* contacts dropping from 22 volts to almost zero, and the *T* relays of other selectors, passing over these contacts, do not act. Interrupters are used to operate the selectors, the motor interrupters being in double. These interrupters have each 20 sets of contact springs, each set delivering current for 20 selectors, which are distributed in such a way that only every second operator's board is served by one and the same set. To avoid sparks, a shunt of 0.5 ohms and a four microfarad condenser are placed in series over every set of contact springs. The current for the interrupters is taken from a 30 volt source and passes through contacts of an electromagnetic switch before reaching the contacts. The electromagnet is attracted by the current and is repelled as soon as the current is cut off, thus separating the battery from the interrupter springs. An alarm bell sounds when a fuse has blown out, and also when a contact set at the interrupter does not give enough contact and thus influences the current to the rotating magnets of the 20 selectors. The bell is sounded by a relay which normally is prevented from acting by the interrupter current from the set of contacts in question. If these springs do not make enough contact, the relay goes into action, lights up a lamp at the faulty set and rings the bell.'

Operation.—The A-operator presses down the key *c* and closes the circuit over the relay *R*. The armature *r* of this relay closes the contact *x* and then contact *y*. The armature *r* forms a circuit from earth, to relay *T*, winding *300*, winding *10*, to arm *t* of the selector. It also closes the circuit for the rotating magnet *D*. The other contact of relay *R* serves to close the night bell relay and to start the motor interrupter during night service. As the circuit of the selector rotating magnet is now closed, the arms *a, b, t,* of the selector pass over the contact sets of the B-board and as soon as one set has been reached, belonging to an open operator, the circuits of relay *T* and *H* are closed by arm *t*, as also the trunk line and key *d* of the B-operator. The relays *T* and *H* act; relay *H* acts so slowly, however, that relay *T* acts a trifle earlier. The two contacts of relay *T* connect the A-operator apparatus to the selector arms *a* and *b*, and current flows into the A-operator's current circuit. A clicking in the A-operator's telephone tells her that an open B-operator has been found and the potential difference between arms *a* and *b* falls to a small fraction of 22 volts. Another contact of relay *T* interrupts the current circuit of the rotating magnet, prevents therefore a further rotating of the selector arms and marks this B-operator as busy in short circuiting the coil of relay *T*. The armature of relay *T* remains attracted by the winding and any other *T* relay of another selector testing this contact is short circuited so that it does not receive enough current for speaking. The line contacts of relay *H* are closed and thus complete the speaking current circuit between A- and B-operator. There is no perceivable clicking in the receiver of the B-operator, as the potential difference between *a* and *b* line at this moment is too small. Of the other three contacts of relay H, one closes the automatic counter current of the B-board, thus recording the call, the second does away with the short circuit of relay *H*, the third closes the circuit of the supervisory lamp. The A-operator gives her call, and then releases her key, thereby interrupting the current in relay *R*. Contact *r* breaks the circuit in the relays *T* and *H*. The current circuit of the rotating magnet at contacts *x* and *y* is opened, before the current in *T* is cut off, thus avoiding all chances of the selector advancing while the key is released. Relays *T* and *H* are cut out. The line contacts of relay *T* disconnect the telephone of the A-operator from the selector arms and prevent interruptions from other circuits when the arms begin to search for an open B-operator later on. Of the other two contacts of relay *T*, one prepares the magnet of the circuit for a new call, the other prepares the bell and motor interrupter circuit. The line contacts of relay *H* disconnect the telephone of the B-operator, interrupt the circuit between telephone and choke coil, and the three contacts cut off the recording device, short circuit the winding of *H*, and break the circuit to the supervisory lamp.—*Zeit. f. Schwachstrom.*

A WORLD'S RECORD FOR WIRELESS TELEPHONY.

The wireless telephone testing station at Nauen in Germany recently established a world's record in wireless telephoning in telephoning newspaper reports over a distance of 700 km. (434 miles). The Telefunken Company has erected a 6,000 km. (3,720 miles) wireless telegraph station using a high frequency generator for direct production of vibrations without sparks. A smaller unit of the same type was used for the telephone work. For more than a half hour newspaper reports were read at Nauen and a number of wireless stations were asked to take down the readings. As far away as Vienna (430 miles) the reports were understood clearly and the report was made that the man at Nauen spoke unnecessarily loud into his apparatus and was asked to speak in a lower tone for better understanding. It is hoped that the new

arrangement used here may be expanded and that wireless telephony across the Atlantic may be at last realized as a practical method of communication.—*Zeit. f. Schwachstrom.*

TELEPHONE EQUIPMENT OF THE NEW HAMBURG LINER "IMPERATOR."

The captain's bridge of the giant liner "Imperator" has six loud speaking telephone sets for connection with the main engine room, the turbine room, the center deck bridge, the anchor watch, the crow's nest and bow of the boat. This is, however, only a very small part of the extensive telephone equipment of the liner. The installation is of the common battery type with automatic call lamp signal system and double automatic cut-off signals. The different connections are made by a switchboard on the first deck, having 100 connections. All employes are therefore enabled to communicate with any part of the ship at a moment's notice. There are no instruments in the various cabins, as past experience has proved this to be unnecessary. Instead of that the cabins have been provided with the push button signal system which is much better and just as efficient. The steamer is also connected with land while in dock in Hamburg or New York. This is especially important just now, since the steamer has to lie out in the Elbe during the reconstruction of the docking and harbor facilities at Cuxhaven. Two double lines were laid in the usual way from Cuxhaven to the Elbe river, and then in a submarine cable out to the place where the "Imperator" anchors, where the cable ends in a rigid box-like arrangement which is always above water level. When the "Imperator" has anchored a flexible aerial cable provided with plug terminals is connected to this box and its terminals and connection between land and boat is finished. This, as also ten other trunk lines are operated from the switchboard, and as there are ten trunk lines, there can be ten different conversations at the same time between ship and Hamburg exchanges.—*Zeit. F. Schwachstrom.*

TELEGRAPH AND TELEPHONE LINE POLES.

Archiv für Post und Telegraphie brings an interesting discussion on the life and use of various types of poles for telegraph and telephone work, based on investigations in various parts of the world.

1. Reinforced concrete poles are to be found in various countries but seem to offer no very decided advantages over wooden poles, due to the fact that they are more expensive than the latter.

2. Iron poles are used in a few places in Europe, not more than twelve or thirteen thousand being found in all of Europe. They are used as a rule more for supporting points for high tension lines or else to support a large number of wires meeting at any one point. In South America, whose lines are owned by private corporations, more than 100,000 are found. The tropics, African colonies, India and Ceylon show a large number of these iron poles. The poles weigh as a rule no more than 150 pounds. In spite of their high cost they are indispensable in tropic countries, as it is impossible at present to furnish enough treated wooden poles, and untreated poles would be destroyed in a short time by insects.

3. Living trees are used in a few wild and uninhabited regions as telephone poles, especially in Tunis, Asiatic Turkey, Congo, Senegal, Australia. In Europe (Bavaria, Sweden), such cases are found, although very seldom, and only then when the cost of transportation or the natural advantages of the country would eliminate the use of the usual poles.

At least 95 per cent of all poles used in the world are of wood. Only very few types of wood are worth using in an untreated condition. If we consider only European and North American conditions, which take about three-fourths of all the poles used, we can set up the following table:

Type of Pole—	Number of Poles Used	Average Life (Years)
Poplar	100,000	2
Pine (Norway, Sweden, U. S.)	1,400,000	4 to 8
Oak	2,400,000	7
Mountain pine (rocky or dry ground)		
Pitchpine (Switzerland, Turkey, U. S.)	600,000	15
Cypress	1,000,000	8 to 10
Red Larch (fir tree)	300,000	10
Chestnut	6,000,000	8 to 15
Cedar	16,500,000	15 to 16

Oak is used throughout the world in about the same proportion, and is to be considered as a temporary measure only. Larch, chestnut and cedar may be compared, however, to the treated wooden poles and are used in places, where they can be cut without trouble and where the transportation of treated timber would be too expensive. The treated poles show about the same life and usefulness in all parts of the world.

Process of Treatment:	Number of Poles.	Aver. Life in Years.
Boucherie Process (Europe, Japan)	11,013,000	14.0
Cyanization (Corrosive Sublimate)	1,800,000	16.5
Tar oil saturation (Europe)	2,800,000	24.8
Zinc chloride (Germany)	200,000	12.2

There are no complete statistics as yet about the Rüping process, which is a combination of the chloride of zinc and the tar oil process. Nearly all of the European countries used the Boucherie process till about 1900, when the cyanization and tar oil treated poles became popular. About the same time that Dr. Boucherie patented his wood preservation treatment, Bréant announced his process in which he treated the timber with zinc chloride. This process never took very well in Europe and is considered inferior to the Boucherie process. The best results have been obtained with corrosive sublimate and with tar oils. The average of life for the former is 17 years, that of the latter 25 years. In recent years the Rüttger and Rüping processes have been introduced which do not treat the timber to complete saturation but use only as much as the timber will absorb. The advantage here lies in greater cleanliness and in saving of oil, not by any means a negligible factor in late years. In the northern portions of Europe the tar oil is used; in the southern portions where the poles sweat a great deal due to the heat, the salt solution is used. Tar oil treatment is best where the poles are to be used within closer vicinity to the factory where they are treated. This is due to the great weight of poles treated with tar oil. With the latest tar oil processes the pole weighs at least 5 pounds per cubic foot wood, while the poles treated with copper sulphate or corrosive sublimate weigh no more than 0.06 pounds per cubic foot. The cyanization and Boucherie methods, however, can be built for very small capacities, and there are a number of plants owned by smaller telephone companies that have a capacity of only 100 poles annually. What methods are the best is a local question and must be decided by every telephone company depending on conditions. The artificial preservation of wooden poles is a very vital question though, and it should be the aim of the industry at least to triple the life of treated wooden poles.

DURALUMINUM FOR TELEPHONE LINES.

Duraluminum is an aluminum alloy containing about

90 per cent pure aluminum, and differing very little in specific gravity from the ordinary aluminum. It has a strength, however, which far exceeds that of aluminum in various respects. There are six different types of duraluminum of which two come into consideration for electrical uses. The specific gravity varies between 2.75 and 2.84, depending on the alloy. The electric alloy has a specific gravity of 2.79. In considering the various characteristics of this metal we shall restrict our article to those that interest us in its relation to electricity. Detailed tests were made to see what influence sea air and sea water would have on the metal. The various metals, as copper, iron, electron, aluminum, duraluminum were placed on one of the German light ships out in the North Sea, where they were exposed not only to sea air and sea water, but also to the alternate action of sea water spray and salt air. Duraluminum was found to be the metal showing the greatest resistance and showed no oxidation phenomena. Nor were there any decreases in strength or expansive force. As many other aluminum alloys suffer when exposed to the open air due to interior decomposition phenomena, this result is very gratifying. In considering the use of aluminum and duraluminum for telephone wires, we must mention the report by Huber-Stockar at the 1911 International Congress at Turin, in which he reported the sudden snapping of aluminum wires without apparent causes, and supported the hypothesis that either the alloy was not properly produced in the first place, or else that the vibrations going out from the poles to the wires weakened the material. Duraluminum wires were tested by the Duraluminum Works during a period of 2½ years and no deterioration of the wires was found to take place. Vibration tests carried on during the same period showed no decrease in strength either.

The use of aluminum for overhead wires both for low and high tension lines goes back for a number of years. The poor results obtained in many cases may be laid at the doors of the users perhaps, rather than the producers, for the former often demanded results for which they made no adequate provision by proper treatment. Aside from pure aluminum an alloy called Spree aluminum was used, which has a strength of 49,700 pounds per square inch and an elongation factor of 3 to 5 per cent. Duraluminum has much greater strength than this and an elongation modulus of 4½ per cent. The strength was found to be 75,260 pounds per square inch, which is greater than copper or bronze wires. Duraluminum also shows a peculiar behavior in electrical conductivity, in that a refining process increases the conductivity from 35 to 40 per cent while having no influence on the resistance. The electrical resistance of refined aluminum is 0.0473 ohms, in other words the conductivity is about 35 per cent of that of copper. This shows that duraluminum can be a rival of copper only if the price is no higher than 10 per cent of the price of copper, and if there are conditions in which the electrical resistance alone is the important factor to be taken into consideration. Duraluminum would be especially valuable perhaps for high tension lines. As regards sagging of lines, duraluminum is the best, coming next to steel. The breaking length of this metal is better than that of any other wire, being 19 km. (11.8 miles). The relative stress under normal conditions seems to show the best results for duraluminum leaving, however, a very low coefficient of safety. Comparing duraluminum with other metals in mechanical properties, we find it to be as good as steel and better than the other wire metals. When using heavy cables as is the case in high tension lines, duraluminum stands out foremost, as it can be produced in cable form similar to copper and needs no steel or iron core for greater strength. The hardness of this metal, taken by the Brinell ball tests, is 144 as against 108 for copper and 40 for aluminum. When using duraluminum wires the distance between poles can be greater and the poles need not be so high, as the sag of the wires is less. Of course, we must remember that the advantages of the metal will be greater, the greater the tension of the current carried, in this way offsetting the greater resistance of the duraluminum. In regard to the making of contacts the same holds true for duraluminum as is true for aluminum. The soldering of aluminum cables which has often given much trouble has been substituted by a special soldering method for duraluminum worked out by the Duraluminum Works. Although the previous points are especially applicable to high tension lines it stands to reason that duraluminum can be used to advantage for low tension lines, especially where great spans are to be bridged by wires. The above is only a brief outline of the points worth mentioning about duraluminum, which will draw attention to this new metal that seems to add another choice to the metals that come into question for overhead lines.—*Elektrotech. u. Masch.*

New York Commission News

The New York Public Service Commission, second district, has authorized the Federal Telephone and Telegraph Company to issue upon the security of its first mortgage dated March 24, 1909, its 5 per cent bonds maturing in 1959 to the par value of $500,000. This authorization is given, provided that not more than $200,000 of such bonds shall be sold at one time, and no further sale shall be had until the proceeds from the first sale shall have been used for certain purposes so that not more than $50,000 shall remain unexpended; that such bonds shall not be sold for less than 83 1/3 per cent of their par value and accrued interest, to give net proceeds of $416,566.86; that no bond thus authorized which shall remain unissued one year from the date of the order shall be sold without further permission from the commission; that such bonds or the proceeds thereof shall be used solely to purchase and retire any of the following outstanding underlying bonds of the companies, which have been merged with the Federal Telephone and Telegraph Company:

Corning Telephone Company	$ 84,000
Frontier Telephone Company	2,500,000
Hanover Telephone Company	100,000
Inter-Ocean Telephone & Telegraph Company	2,000,000
Ithaca Telephone Company	95,000
Livingston County Telephone Company	110,000
Penn Yan Telephone Company	50,000
Salamanca Telephone & Telegraph Company	39,000
Valley Telephone Company	110,000
Watkins Telephone Company	25,000
Wellsville Telephone Company	40,000
Wyoming County Telephone Company	29,000

To Save Telegraph Poles

In France a system, invented by Dubois, is used to preserve telegraph poles from rotting. The bottom of the pole up to, and a little above, the surface of the ground is encased in an earthenware pipe. The space between the pipe and the pole is filled with a mixture of sand and resin, which, on solidifying, becomes waterproof.

When the Banker Cashes Your Check

By Walter K. Towers

JOHN SOMMERS was keeper of the general store at Elmwood. Allan McPherson was owner and head of the Elmwood Savings Bank. The relations between the two men were far from friendly, but as there was no other bank near at hand Sommers maintained a commercial account in McPherson's institution. One Tuesday morning he purchased a load of potatoes from Clyde Webb, a prominent farmer of the vicinity. Sommers paid Webb immediately, giving him a check for twenty dollars properly drawn on his account in the Elmwood Savings Bank. Webb took the check to the bank and presented it to McPherson, who was in the teller's cage.

"What did you do, go and sell that load of potatoes to Sommers?" inquired McPherson.

"Yes; why not?" replied Webb.

"Well, you might have given me a chance at them. You know I'm buying produce as well as banking."

"That's no reason why I shouldn't sell to John Sommers."

"Well, I'll show you you're a fool to sell to him," angrily asserted the banker. "He paid you with a check, didn't he? And you took it! and it ain't no good at all, see!"

"What's the matter?" asked Webb.

"Why, he's no good financially, and his check's no good, and you can't get any money on it."

Webb returned to Sommers, and Sommers hastened to the bank, knowing that his balance stood close to four hundred dollars. After a heated discussion at the bank, Sommers travelled to the office of his legal counsellor. As a result action was begun against the banker because of his failure to cash the depositor's proper check, and substantial damages were recovered because McPherson's action had injured Sommer's standing and credit in the community.

This case illustrates what is perhaps the primary duty of the banker to his depositor—to pay all proper checks drawn on him against adequate deposits. If the banker fails to do this, either willfully or through mistake, he must answer to his depositor. If the depositor whose check was wrongfully dishonored suffered any damages he may recover the amount against the banker. Injury to credit and business standing are the damages usually complained of in such cases. The banker is entitled to a reasonable time after presentment in order that he may examine into the state of the account against which the check is drawn. Good bankers have their affairs so arranged that this is a matter of seconds rather than minutes.

When Sommers sued McPherson, McPherson defended his action on the ground that while Sommers did have a balance of about four hundred dollars the bank held Sommer's note for five hundred dollars, which was to fall due within a week. The banker insisted that he had a right to retain Sommer's deposits to insure payment of the note when it should fall due. His position was not justified in law and furnished him with no effective defense. A banker may set-off an indebtedness that is due by the depositor to the bank against the deposit, but he may not set-off one not yet due. Sommers could not be required to pay the note until its maturity, and until then it was not an effective obligation against him.

It not infrequently happens that the holder of a check for say ten dollars, will present it at the bank for payment and discover that the depositor has a balance of but seven. Often the holder of the check would be glad enough to get the proportion that the deposit would cover then and there. But the bank need not make part payment. This is because it is entitled to the check for use as a voucher in settling with the depositor.

When the bank pays a proper check it has a right to charge payment against the depositor. It may be that the bank will choose not to dishonor the check for ten dollars when a balance of but seven remains and will accommodate its depositor by paying the check in full. This is what is known as an "overdraft," and while contrary to the printed rules of most banks is still frequently done in ordinary commercial practice. If the bank allows an overdraft, in effect advancing money for its depositor, it may recover the amount from him.

Bankers do not take time to investigate a depositor's account for every check that is presented to the bank for payment. They depend upon memory, and confidence in the depositor, in many instances. So it sometimes happens that a bank will pay a check under the belief that the signer has an adequate balance on deposit, when such is not the case. On discovering its mistake banks have sometimes endeavored to recover the money paid the person who presented the check, but they have not been successful. In one sense of the word the bank paid under mistake, and mistake is sometimes ground for recovery of money paid, but not by a bank under these circumstances.

Sometimes after a person has signed and delivered a check he wishes to recall his action. He immediately gets in touch with his bank on which the check was drawn and instructs it not to pay that check when it is presented. This is known as "stopping payment." Stopping payments ends the bank's duty and also its right to pay the check when presented. It not only need not pay the check, but it must not pay it. If it disregards its depositor's instructions and pays the check on which payment has been stopped it is the loser as it may not charge that payment against the depositor's account.

A. L. Sullivan owed James P. Long $47.00, but by mistake he filled out the check to James A. Long and mailed it in an envelope addressed to James A. Long, and a James A. Long received it and cashed it at a bank. The bank lost the money it paid out on the check. This was because a bank is bound to make certain that it is paying the check to the proper party. In law the middle initial is not part of a man's name and so the check was payable to James Long.

If there are two persons of the same name it becomes the duty of the bank to pay it to the person of that name who rightfully may receive it. So it is that bankers will cash checks only for responsible parties known to them.

Thus we have illustrated an extreme case under the general proposition that a bank paying a check must do so only to the proper party. If anyone steals or finds a check, or forges an indorsement, and so secures payment

from the bank, the bank must stand the loss. If a check has been indorsed in blank, or was drawn in such form that it is payable to bearer, any bearer may receive payment on it and a bank is justified in paying it to any bearer, unless there are some special circumstances to cause it to believe that the bearer is not the rightful owner of the check and not entitled to receive payment of it. When you draw a check payable to "the order of John Smith" you are entitled to the assurance that the bank will pay it to no one other than John Smith or parties to whom he may transfer it by valid indorsement.

Paul Greer, in Chicago, signed a check for $900.00, directing his local bank to "Pay to the order of Leon Young." Leon Young received the check in St. Louis and endorsed it as follows, "Pay to the order of The Copper Exchange Bank, Leon Young." He handed it to his clerk, together with a deposit slip, and told him to take it to the bank and deposit it. The clerk tore up the deposit slip and told the bank teller that Mr. Young wanted the cash. The cash was given to him and that was the last that was heard of the clerk or the $900.00. Again the bank was the loser for the check was endorsed to the bank and not to the clerk, nor in blank by Leon Young so that the bearer might receive the money. If Young had simply written "Leon Young" on the back of the check he would have been the loser. So if you are to send a check to a bank for deposit, and do not trust your messenger absolutely, indorse it to the order of the bank and not in blank—then the bank will not deliver it to the bearer except on your writen order.

In the case of forgeries the banker also bears a heavy responsibility. No other checks may be charged against the account of a depositor than those he actually signed, and which have been paid to the proper party. If the bank pays a forged check it is the loser, unless the depositor in some way contributed to the fraud practiced on the bank and so is not in the position of an innocent party. In the case of raised checks the banker also must bear the loss, again with the proviso that the depositor who signed the check in no way contributed to the fraud. If he drew the check so carelessly as to make the fraud possible, or in any way conspired with those who raised the check, his position is not so favorable. We have before noticed that the bank loses if it pays a check to a party not entitled to receive payment of it and that this is true though the fraud be accomplished by a forged indorsement. Of course a bank paying money to a party claiming his rights through a forged indorsement may recover from that person—always provided it can catch him.

Such are the rights of the depositor against his banker. Remember that the banker bears these heavy responsibilities and if in dealing with him he insists that you comply with formalities that to you seem useless remember the strict requirements made of him. Handle all your checks in a business-like manner.

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Argue on Indiana Interconnection

Section 8 of what is known as the Indiana public service commission act contains provisions which vitally affect the telephone situation in South Bend. The recent action of Mayor George R. Durgan, of Lafayette, Ind., in giving the two telephone systems of that city five days in which to perfect physical connection draws direct attention to what may be done if the citizens of the city so desire.

The act according to those who heard the discussion before its passage and in the opinion of City Judge G. A. Farabaugh, is a sweeping measure with the purpose of forcing competing telephone companies to unite. Upon the request of any interested person, corporation or association the commission must investigate and providing it is for public convenience and necessity and provided also that it does not irreparably injure the company they must unite on order of the commission.

In short if a subscriber on the Bell telephone wishes to talk to a Home telephone subscriber telephone companies must furnish that connection. If a subscriber on the Home telephone would talk with a Bell subscriber in Chicago such connection must be furnished. So in the case also of concerns who have private switchboards with one company. Connection with the other company may be demanded.

As pointed out by attorneys, the measure is sweeping in its effect. It reads specifically, "any person, association or corporation" may ask for investigation by the commission and the commission must, under the new conditions.

Moreover compensation for such service must be made by the companies to each other and not directly by the subscriber. The act provides also that in case the companies fail to agree on term and compensation it shall devolve upon the commission to do so. The law reads as follows:

Every public utilities for the convenience of telephone messages shall permit a physical connection or connections to be made, and telephone service to be furnished, between any telephone system operated by it, and the telephone toll line operated by another such public utility or between its toll line and the telephone system of another such public utilities, or between its toll line and the toll line of another such public utility, wherever public convenience and necessity require such physical connection or connections and such physical connection or connections will not result in irreparable injury to the owner or other users of the facilities of such public utilities, nor incur any substantial detriment to the service rendered by such public utilities. The term "physical connection" as used in this section shall mean such number of trunk lines or complete wire circuits and connections as may be required to furnish reasonably adequate telephone service between such public utilities.

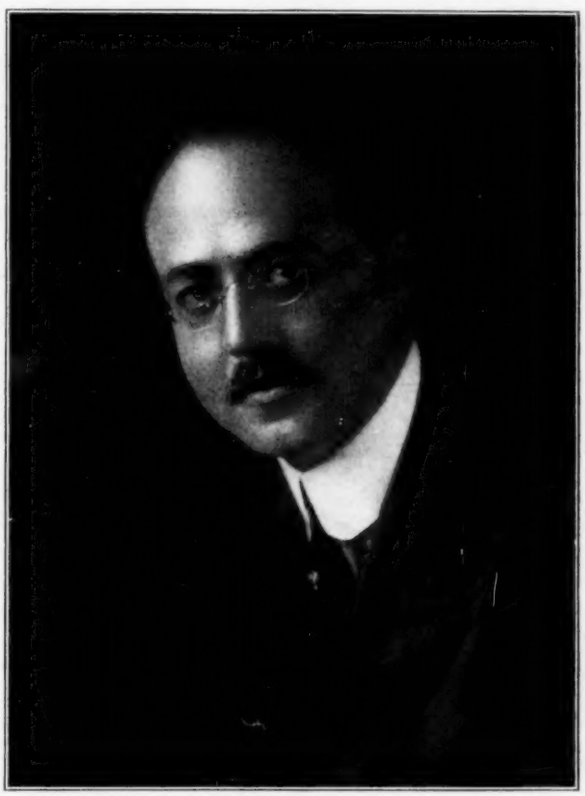
In case the failure to agree upon such use or the conditions or compensation for such use, or in case of failure to agree upon such physical connection, or connections, or the terms and conditions upon which the same shall be made, any public utility or any person, association or corporation interested may apply to the commission and if after investigation the commission shall ascertain that public convenience and necessity require such use or such physical connection, and that such use or such physical connection or connections would not result in irreparable injury to the owner or other users of such equipment or of the facilities of such public utilities, nor incur any substantial detriment to the service to be rendered by such owner or such public utility or other users of such equipment or facilities, it shall by order direct that such use be permitted and prescribe reasonable conditions and compensations for such joint use and that such physical connection or connections be made and determine how and within what time such connection or connections shall be made, and by whom the expense of making and maintaining such connection or connections shall be paid.

Such use so ordered shall be permitted and such physical connection or connections so ordered shall be made and such conditions and compensations so prescribed for such use and such terms and conditions upon which such physical connection or connections shall be made, so determined, shall be lawful conditions and compensation for such use, and the lawful terms and conditions upon which such physical connection or connections shall be made, to be observed, followed and paid, subject to recourse to the courts upon the complaints of any interested party as provided in section 78, 286 inclusive, and such sections so far as applicable shall apply to any action arising on such complaint so made. Any such order of the commission may be from time to time revised by the commission upon application of any interested party or upon its own motion.

Who's Who in the Telephone Game

Facts and Fancies About a Man You Know or Ought to Know

IT is a common tendency to look for the foundation of a man's power in his educational opportunities instead of his temperament and inheritance. The possession of certain rare qualities in a man invariably emphasize that the springs of genius are purified and directed in their flow by the processes of training, though fed from deeper sources." Those were the words written for Milo Gifford Kellogg, the father of James Gifford Kellogg. But when they were written for the father, he had attained the age of sixty years—his son is only thirty-two. The father was born in the country and after receiving his degrees sought the city. The son was born in the city and after graduation, took up his abode in the country.



He Grew up with the Telephone.

Many things have been said for the Kellogg Switchboard and Supply Company and of the men who have been responsible for its tremendous success, but not one little word for James Gifford Kellogg. Around the factory they call him Jim. They formed the habit years ago when J. G. was Jim to everybody. Not that he isn't that yet, but it does make a difference to some people after you grow out of your knickers, go away to school, come back with the coveted sheepskin, get married, and join the ranks of the executives up front. The boys at the bench where you used to work are timid with that old familiarity stuff unless you prove you haven't forgotten what the grime means. As an executive of the works, with his desk right next to the president, Jim Kellogg has proven to his men that he hasn't changed. There is nothing that appeals to James G. so little as the snob. He is plain folks all the time, due to temperament and inheritance.

If the Telephone Pioneers were as liberal with their by-laws as they should be, Mr. Kellogg would be four years to the good as an eligible. He dates his connection with the telephone business back to 1889 when he recalls parts of an earnest conversation on the subject of the telephone between his father and his uncle, Enos M. Barton at Antwerp. He was making his first trip abroad at the age of eight. They were discussing spring jacks and Jim wanted to know all about it. Telephones before and after school was the din that rang in his ears through boyhood to manhood. He grew up with the telephone; monkeyed around during vacation in the shops where they were made; completed the mechanical course at Cornell in order that he might eventually take a hand at the game himself. Then he entered his fathers's experimental shop in 1906 and remained there until three years later when he came into his own at the main works.

Mr. Kellogg is vice-president of the Kellogg Switchboard and Supply Company; a director and member of the executive committee. He is an associate member of the American Institute of Electrical Engineers and belongs to the University Club of Chicago. His residence is in Winnetka where he stables his automobile; houses his wife and son and fusses around in his own garden patch. Mrs. Kellogg was a Chicago girl. The lure of foreign travel enticed the Kelloggs abroad during their honeymoon, nearly three years ago. They toured Italy and Egypt, including the Nile to the first cataract, and took in many other Mediterranean points of interest.

James Gifford Kellogg is the largest member of his family. When he dives into the ocean his displacement is equal to a tenth of a ton. He qualifies without argument for the six-footer class; has no wrinkles and no gray hairs. Add twenty years to him and he will be a double of his father. He is succeeding fairly well with a mustache which is confined to the scantiest proportions to conform with present fashions, but aside from that he isn't a stickler for the modes. J. G. Kellogg is a kindly, companionable man, well liked by his associates and admired for his sturdy ability. He has no inventions in his name, but he has helped inventors with his unselfish suggestions, and is responsible for a number of improvements both in the finished product and the method of its manufacture. He has no hobbies; doesn't care a rap about baseball or athletics, indoors or outdoors. He does drive a car, in which he delights, and smokes anything that will burn. He lives in awesome fear that his concern will get so big, eventually, that it will have to have a goat, and that he may be it. He reasons that the smooth-going of a double-decade or more just possibly might get a jar some time—not that there are any outward evidences—far be it from that, but then a man naturally has to have something to get excited about. James Gifford Kellogg was born in Chicago May 31, 1881.

Convention at Sedalia, Missouri

At Sedalia, Mo., August 20th and 21st, the Missouri Independent Telephone Association held its annual convention. The attendance was excellent, owners and managers of operating companies from all parts of the state being present. A constitution was adopted by the association and telephone talks by well known men were carefully listened to. The next annual meeting will be held in November, 1914, the place to be decided by the executive committee. The election of officers for the ensuing year resulted as follows:

President, Houck McHenry, Jefferson City; first vice-president, M. L. Golloday, Holden; second vice-president, H. C. Todd, Maryville; third vice-president, C. W. Boutin, Cape Girardeau; fourth vcie-president, T. J. Buchanan, California; secretary-treasurer, E. A. Hook, Appleton City; executive committee, Dr. S. T. Meil, M. L. Golloday, C. W. Boutin, R. A. Guthrie, J. A. Hudson, H. C. Todd, William Russell, G. V. Ross and William H. Bossett.

One feature of the convention was the interest taken in the Telephone Service Association of Chicago, whose secretary-manager, Frank L. Eldridge, attended. Mr. Eldridge not only sold a large number of the Service Association's Book of Operating Rules, but also signed up many new members; and he states that the visitors were so keenly interested that some of them visited him at his hotel to get further information about the work of the Service Association.

This organization is now well on its feet and is making great progress. The matter of finances, that stumbling block of so many new associations, has been arranged so that, at the present rate of progress, future stability is assured, and most of those early members who were delinquent in their dues are sending in remittances and signifying their desire to continue.

The action of J. W. Coffey in arranging a system of accounting for the Service Association is already proving a great help because of Mr. Coffey's familiarity with the methods employed by the commissions. The Service Association has started its series of bulletins with an excellent form for billing long distance business and a short treatise on the value of courtesy.

Petition for County Ownership

Petitions for county ownership of the Lincoln, Neb., telephones are in the hands of the managers of the campaign. It is the intention to file them during the first part of this month, but in the meantime a meeting of the committee of fifty or the entire organization is to be held to discuss methods of promotion.

Fully thirty men have blanks out, and have been circulating them with more or less vigor, and so far as could be learned the success of each has not been inquired into and no compilation of totals made. It is estimated that when the circulators make returns the number of names will far exceed the required 1,600, or 10 per cent of the voting strength of the county.

The law requires a petition of 10 per cent of the electors of the county. The largest vote ever cast was about 16,000, but it is known that the full voting strength far exceeds this number. To be on the safe side the petition managers intend to get plenty of names. Secretary Peterson estimated that before the date of filing the total will be up to 3,000 names.

The law provides that the submission of the bond issue to the people can take place either at a special or a general election. The discretion as to which sort of election is to be called is left with the county commissioners. Nor does the law state how soon after the filing of the petition such election is to be held. It does make the submission mandatory, but does not even require that this submission, if the commissioners were hostile, should occur at the next general election.

Another question has been raised by those interested in the movement. After bonds were voted and a decision reached as provided for by law against the purchase of the private plants, would the county be compelled to secure a franchise from the cities and towns in which it wished to operate its telephone system? The county option telephone law makes no reference to franchises. A telephone company, whether owned by private persons or the public, has to use the streets and alleys and in places must tear up pavements. Leaders of the movement say the question does not worry them, for if the question of a county system proved popular as shown by a vote of the people they believe no difficulty in securing a franchise would be experienced, even admitting the necessity of securing one.

The city attorney is considering the advisability of seeking an injunction against the new rates and in doing so to ask permission to open the question of physical valuation. Some lawyers say that an order of the railway commission can no more be enjoined than can a decision of the district court, but that objectors to such order must appeal as provided by law. This law puts the commission's orders on a par with the decisions of district courts. Were an injunction to be secured a bond would as a matter of course have to be put up by the city, if it sought such an order, to cover any loss the company might experience. The commissioners have indicated a disposition not to enter any such situation as that.

Canton, China, Has New Exchange

The construction of the new telephone exchange at Canton, China, is under the supervision of a British firm. It is to be three stories, reinforced concrete floors, steel beam columns coated with concrete, and the cost of construction is about $60,000, local currency. The building covers 100 by 60 feet. The value of the land is about $20,000, local currency. This is on the Bund adjoining the Young Men's Christian Association property.

The local telephone administration at Canton is a part of the national system, which is under the Ministry of Communications at Peking. Purchases of equipment are usually made through Shanghai. No purchases over $20 gold can be made without sanction from Peking.

At Canton equipment has been ordered principally from the Nippon Electric Company, Mita Shikokumachi Shibaku, Tokyo, Japan, owing to the fact that until recently the engineer of the local administration was a Japanese. In the new exchange to be erected new equipment will be installed, the contract having been given to the Ericsson Manufacturing Company, a Swedish concern, represented by a Hongkong firm.

The Canton telephone system consists of four exchanges, as follows: Head office, 553 subscribers; Sai Kwan office, 587 subscribers; Honam office, 165 subscribers; Tung Kwan office, 126 subscribers.

All these offices are situated in Canton and suburbs. Each subscriber is on one line only. The type of equipment is the magneto. During the daytime the pole changer equipment is used; after 9 p. m. the generator. The total length of telephone wire in use is approximately 1,441 miles. No telephone apparatus is manufactured in China.

Poles Purchased in 1911

Forest Service Report

STATISTICS showing the number of wooden poles purchased in the United States in 1911 by steam and electric railroads, electric light and power companies, and telephone and telegraph companies were compiled, as in preceding years, from reports obtained by correspondence. Information with respect to prices paid for poles, and the quantities of cross arms, brackets, and insulator pins, shown in the report for 1909, was not requested in 1911, but for the first time the kinds of wood treated by each of the principal preservatives employed were obtained. The figures included the pole purchases of practically all of the telephone and telegraph, electric-railroad, electric-light and power, and steam-railroad companies, and accordingly reflect very closely the actual drain upon the pole timbers of the forests.

Table 1 shows the total numbers and principal kinds of poles purchased by the several classes of consumers from 1907 to 1911, inclusive.

TABLE 1.—*Poles purchased, classified by kinds of wood: 1907 to 1911.*

Kind of Wood.	1911	1910	1909	1908	1907
Cedar	2,100,144	2,431,567	2,439,825	2,200,139	2,109,477
Chestnut	693,489	677,517	608,066	516,049	630,282
Oak	199,590	265,290	236,842	160,702	76,450
Pine	161,690	184,677	179,586	116,749	155,960
Cypress	72,995	75,459	77,677	90,579	100,368
All other.....	190,112	236,184	196,744	164,936	210,731
Total	3,418,020	3,870,694	3,738,740	3,249,154	3,283,268

In 1911 the total purchases amounted to 3,418,020 poles; of these, 2,402,724, or 70.3 per cent, were purchased by the telephone and telegraph companies; 787,649, or 23 per cent, by the electric railroad and electric light and power companies; and 227,647, or 6.7 per cent, by the steam railroads. The total number of poles purchased represents a decrease of 452,674 as compared with 1910, and of 320,720 as compared with 1909; but it exceeds the totals for 1908 and 1907 by 168,866 and 134,752, respectively.

The decrease in the purchases of 1911 as compared with 1910 was confined to telephone and telegraph companies and steam railroads, while substantial increases in purchases were reported by the electric railroad and electric light and power companies.

Five kinds of wood—cedar, chestnut, oak, pine, and cypress—supplied over 90 per cent of the pole requirements of the United States during each of the five years covered by the table.

Cedar, which has long been the preferred wood for pole purposes, supplied 61.4 per cent of the total number reported in 1911.

Purchases of chestnut increased substantially from 1908 to 1911, amounting in the later year to 177,440 more than in the earlier. A large part of this increase is due to the chestnut bark disease, which has killed large quantities of chestnut timber in Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, and Maryland. As a result strong efforts have been made to place the wood on the market before it has deteriorated through the attacks of insects and fungi. The bark disease in itself does not injure the value of the wood for ues as poles.

The number of oak poles used increased rapidly from 1907 to 1910, but fell off greatly in 1911, in which year the number reported was more than 65,000 below the figure for 1910. Oak poles, which are marketed in relatively short lengths, have been used extensively in rural telephone lines, the development of which has been very great in recent years. The figures indicate, however, that this development was much less marked in 1911 than in 1909 and 1910.

The use of pine has increased but little since 1907.

The demand upon cypress has slowly fallen off year by year, the number of cypress poles purchased in 1911 being only about three-fourths as great as the number purchased in 1907. This falling off is due to the high price of cypress lumber, and to the fact that this timber is found generally in sizes too large for poles.

The principal kinds of wood included under the term "all other" in the table are juniper, redwood, Douglas fir, tamarack, osage orange, and spruce.

The preferred species have the general physical qualifications of durability in the soil, strength, lightness, straightness, a surface which will take climbing irons readily, and comparatively slight taper. The various species of cedar combine these qualities in high degree. Cedar poles are cut principally from the white cedar of the lake states, the red cedar of the Northwest, and the southern white cedar of North Carolina, Virginia, and New Jersey. Chestnut is cut principally in the Atlantic Coast States from Georgia to New Hampshire. Oak, a very widely distributed species, is cut for poles chiefly in the hardwood states of the Ohio and Mississippi valleys. Most of the pine reported is that commonly known as southern yellow pine, and includes several species—longleaf pine, shortleaf pine, loblolly pine, and some others. Of these, the most durable is the longleaf pine, while the loblolly pine gives very brief service unless it is treated with a preservative. In the West another species—western yellow pine—is reported, which also requires preservative treatment.

Table 2 shows the number of poles purchased in 1911, classified by lengths and by kinds of wood. Poles are purchased chiefly in the round form, although redwood is usually sawed, and pine also to a relatively small extent.

TABLE 2.—*Poles purchased, classified by lengths and by kinds of wood: 1911.*

Kind of Wood	Total.	Under 20 feet.	20 feet and over, but under 30 feet.	30 feet and over, but under 40 feet.	40 feet and over, but under 50 feet.	50 feet and over.
Cedar	2,100,144	181,114	1,286,306	480,243	121,045	31,436
Chestnut..	693,489	24,517	298,710	289,702	66,421	14,139
Oak	199,590	114,493	65,803	14,311	3,815	1,168
Pine	161,690	28,335	84,940	29,390	10,403	8,622
Cypress..	72,995	5,675	40,492	23,229	3,320	279
All other.	190,112	50,594	85,565	25,344	11,996	16,613
All kinds..	3,418,020	404,728	1,861,816	862,219	217,000	72,257

Poles are usually purchased in classes differing in length by 5 feet, and under specifications designating the diameter at the top and at a point 6 feet from the butt. To simplify the tabulation, the number of poles purchased has been classified in the table under lengths differing by 10 feet. By far the largest number of the poles used are under 30 feet in length, purchases of poles of this class representing about two-thirds of the total number in 1911. This is due to the fact that the telegraph and telephone companies, which purchase the largest numbers, commonly use the shorter sizes. Poles 40 feet and over in length are purchased in large numbers by the electric light and power companies and electric railroads.

Each of the leading kinds of wood contributed poles

of all the lengths covered by the table (although it may be noted that the number of cypress poles 50 feet and over in length was very small). Cedar demonstrated its general usefulness as a pole timber not only by the total number purchased, but by the large number of purchases shown under each length; in fact, it led all other species in all lengths. In the case of chestnut, the number of 30 to 40 foot poles purchased was nearly as great as the number of the 20 to 30 foot lengths, while, in the case of all the other kinds of wood, purchases of the 20 to 30 foot poles greatly exceeded those of the 30 to 40 foot lengths. Considerably more than half of the oak poles reported were under 20 feet in length—a very much larger proportion than in the case of any of the other kinds of wood.

As compared with 1910, the number of poles under 20 feet shows a decrease of 237,231, and the number between 20 and 30 feet a decrease of 325,635. On the other hand, the purchases of poles 30 feet and over in length show gains aggregating more than 100,000. These figures indicate a very material decrease in the activity of those companies which use the shorter lengths—particularly the rural telephone lines—and increased activity by the electric railroad and electric light and power companies, which purchased the bulk of the longer poles.

PRESERVATIVE TREATMENT.

The woods used for poles in the United States are chiefly those which are naturally very durable in contact with the soil. The life of timber under this condition varies considerably according to the species, to differences in the wood of the same species, to the character of the soil, and to climatic conditions. Cedar, chestnut, cypress, juniper, and redwood usually last from 10 to 15 years, while white oak has an average life of somewhat less than 10 years.

The resistance of poles to decay can be considerably increased by the use of preservatives. Wood preservation is now on a firm footing in the United States, but the advantages which this practice affords are by no means fully utilized by pole consumers. Preservatives not only add from 3 to 15 or more years to the service of the woods now commonly used for poles, but also make it possible to use cheaper woods which in their natural condition lack durability in the soil although possessing all the other qualities necessary in pole timber. The durability of woods which ordinarily last but a few years can thus be increased to more than double the normal life of cedar.

Poles may be treated by the application of the preservative to the entire pole or only to those parts which commonly decay rapidly in the locality in which it is used. The preservative may be applied with a brush; the pole may be dipped or stood in an open tank containing the preservative; or the entire pole may be inclosed in a cylinder full of a preservative and subjected to sufficient pressure to cause it to penetrate the wood. In the United States poles are commonly treated simply by the application of one or two coats of the preservative with a brush. This is the cheapest and most convenient method, but also the one which adds the least service, since the penetration of the wood by the chemical is usually relatively slight. A comparatively small number of poles are treated in open tanks or in closed cylinder tanks and the wood thus much more thoroughly protected. About 181,000 linear feet, or the equivalent of 7,240 poles 25 feet long, were treated in tanks in 1911.

The total number of poles which received some kind of treatment in 1911 was 656,504, or 19.2 per cent of the total number purchased. In 1910, 824,673 poles were treated, or 21.3 per cent of the total number purchased in that year.

Table 3 shows, for 1911, the total number of poles treated, classified by kinds of wood and preservative.

TABLE 3.—*Number of poles treated, by kinds of wood and by kinds of preservative: 1911.*

Kind of Wood.	Aggregate.	Kind of Preservative					
		Refined coal-tar oils.	Coal tar.	Paint.	Charring.	Crude oil.	Miscellaneous.
Cedar	436,734	363,148	32,851	10,074	11,810	5,525	13,326
Yellow pine	88,180	83,602	1,401	385	300	400	2,092
Chestnut	77,625	68,759	3,124	3,442	20	....	2,280
Juniper	15,774	12,767	2,302	....	....	....	705
Oak	9,077	6,991	1,193	153	640	....	100
Cypress	7,997	5,921	546	20	....	....	1,510
Douglas fir	6,628	5,285	300	....	....	32	1,011
Western pine	5,075	4,704	250	65	56	....	....
White pine	3,030	2,329	541	....	....	....	160
Spruce	1,961	1,448	503	....	13	....	....
Tamarack	1,260	640	605	....	15	....	....
Lodgepole pine	1,253	1,128	....	....	125	....	....
Redwood	817	780	25	....	....	12	....
Ash	500	.....	....	....	....	....	500
Locust	405	.....	....	....	....	....	405
Elm	150	.....	....	....	....	....	150
Osage orange	21	.....	21	....	....	....	....
Cottonwood	14	.....	....	14	....	....	....
Basswood	3	3	....	....	....	....	....
All kinds	656,504	557,505	43,659	14,153	12,979	5,969	22,239

Practically all of the poles were treated by the less effective methods, which add but relatively few years to the service of the wood. Of the total number treated, cedar poles constituted two-thirds, and cedar, yellow pine, and chestnut poles together amounted to 91.8 per cent. From this it is apparent that treatments were applied principally to durable species. Less than 100,000 poles of the less durable species, which include some of the species classed under yellow pine, all of the western pine, white pine, and tamarack, were treated. It is apparent that the opportunities which exist for making first-class pole timbers from the less durable woods are not being utilized to any considerable extent, and that pole consumers have first turned their attention to increasing the durability of the woods which they have already been using. Loblolly pine of the southern states, lodgepole pine, western pine of the Rocky Mountain region, and many other woods deserve careful consideration as prospective pole timber, since they take treatment readily and in many places offer consumers a chance to use local woods instead of shipping poles from distant regions at considerable cost.

The principal preservatives used for treating poles are those classified as refined coal-tar oils. Under this heading are included creosote oil and various proprietary preservatives reported as carbolineum, C. A. Wood Preserver, S. P. F., and others. The bulk of the poles in this class were treated with the proprietary preservatives. Creosote oil was used in treating 159,321 poles, of which 50,021 were cedar and 83,035 yellow pine.

Wood preservatives properly refined from coal tar are considered among the most effective known when properly applied. Coal tar was used in the treatment of 43,659 poles, three-fourths of which were cedar.

Over 14,000 poles were treated with paint—a preservative concerning the effect of which little is known. Judging by tests which have been made on greenhouse timbers, probably two or three years' life is added by the use of paint.

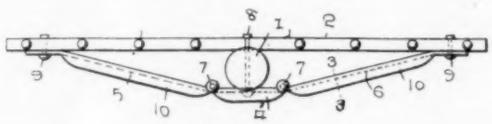
Charred poles in experimental lines have shown less decay than untreated poles. Poles are often charred by painting them with crude oil and burning the oil. Crude oil alone has proved a valuable preservative when the wood was thoroughly saturated with it, but when the poles were merely painted with this preservative, or the oil used in quantities around them when they were set, the results have proved unsatisfactory.

Recent Telephone Patents

By David S. Hulfish

1,048,496. Brace for Cross Arms. Isaac Cline, Huntington, Ind. This improved brace is made of three pieces of angle iron, hinged together. The middle piece bolts to the pole and the outer ends of its two hinged parts are bolted to the cross arm.

1,048,561. Selective Signaling System. Judson McFell, Chicago, Ill. Many selecting devices for telephone stations comprise the ratchet tooth or stepping principle by which a number of currents sent over the line from the central office may step a "selector" at each of the stations, each station's selector requiring a number of steps different from any other selector to enable it to ring the call bell of the station. The object of the improvement in this patent is to extend the usefulness and reliability of such a selecting equipment to a line having a large number of stations. To do this, two stepping selectors



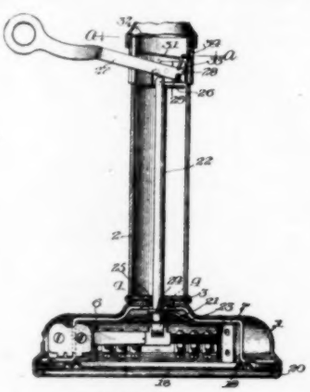
1,048,496.

are placed at each station, the control over the telephone line from the central office being first upon one selector and then upon the other, the calling circuit of the telephone being such that both selectors must be properly set. The range of usefulness of the complete device thus has been much enlarged.

1,048,773. Dry Battery. F. L. White, Lakewood, Ohio, assignor to National Carbon Company, Cleveland, Ohio. The feature of novelty is an oiled lining for the zinc wall.

1,049,405. Knob Insulator. F. Schaub, Jersey City, N. J. The knob is in two parts and the wire is held between the parts. The lower part contains cross groove for the wire and a convenience is found when fixing the top in place by having a groove all around it, so that it may fit in any position.

1,049,499. Receiver. Oscar M. Leich, Genoa, Ill., assignor to Cracraft, Leich Electric Company, of same place. The im-



1,049,526.

proved receiver is of the direct-battery type without permanent magnet. The electromagnet of the receiver is mounted in a slotted cup of magnetic material having its edges near the diaphragm. A dead weight is included in the receiver case to make the complete device heavy enough to operate the hook switch.

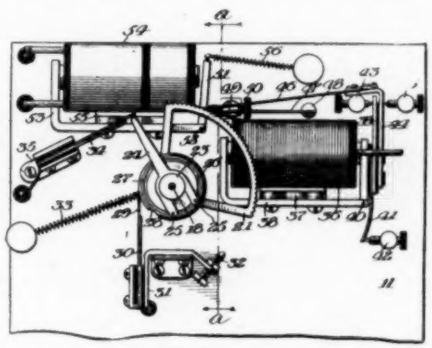
1,049,526. Desk Telephone. Niels Pederson, Genoa, Ill., assignor to Cracraft, Leich Electric Company, of same place. The bank of springs from the hook switch is in the base of the stand, and a vertical rod passes from the moving spring upward. The top end of this rod is pressed by the hook lever, which lever is removable for shipment of the telephone without deranging any of the remaining apparatus parts, and again replacable without opening the case of the instrument.

1,049,537. Telephone Selecting Switch. Harry O. Pugh, Sandwich, Ill., assignor to Sandwich Electric Company, of same place. This is a selecting device suitable for use at party-line telephone stations where the selection is accomplished by sending over the line a series of impulses corresponding in number to the number of the station. It has a movable toothed part, and a driving magnet and pawl for driving the toothed part step-by-step. A releasing magnet lifts the pawls and permits the toothed part to return. Contacts for circuits may be closed when the toothed member is in its position of rest, and others when it has taken any desired predetermined number of steps.

1,049,568. Time-Controlled Signaling Device for Telephones. Irving D. Fellows, Syracuse, N. Y., assignor of part to James H. McCartney, Rochester, N. Y. The device comprises an electric alarm device and a clock, together with circuits for connecting it to a telephone line in such way that an audible alarm will be given upon the telephone line whenever the line has been in use continuously to exceed some predetermined period for which the device has been "set."

1,049,822. Antiseptic Attachment. Edward A. Dieterich, New York, N. Y. A band of thin fabric is placed before the mouthpiece of the transmitter and means provided for moistening it in a tank of antiseptic solution.

1,050,101. Improved Telephone Switchboard Details. Peter C. Burns, Chicago, Ill. A combined drop and jack, provided with a rectangular frame of magnetic material, a magnet fixed to the rear end of the magnetic frame in such manner that it may be removed easily, a jack removably placed at the side of the frame, a drop shutter, and a plug having a shoulder to restore the drop shutter when the plug is inserted in the jack.



1,049,537.

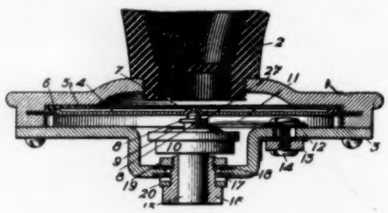
1,050,104. Speech Repeater. John J. Comer, Chicago, Ill., assignor to Automatic Enunciator Company, Chicago. This is of the type of repeater in which an electrode of a carbon cell is moved by the armature of an electromagnet. A "differential" carbon cell is used, composed of a cell of three electrodes, the outer two being fixed and the middle one movable between them. The electromagnet's armature is provided with an adjustable retractile spring, and so arranged that the air gap may be varied. The whole device is enclosed in a case with a novel arrangement of mechanical supports and electrical terminals such that one equipment may be substituted for another in any circuit with great ease.

1,050,304. Transmitter. Charles E. Scribner, Jericho, Vt. The novelty is found in the manner of supporting the carbon cell. The front electrode is pressed against the diaphragm by a spring which is attached to the bridge and which engages a shoulder on the stud of the front electrode. The back electrode is held by the bridge in the usual manner. By this means, the tension of the spring mentioned is opposed to an equal tension created in the diaphragm and the front electrode thus is held very sensitively.

1,050,404. Telephone Attachment. William C. Ude, West Haven, Conn. The attachment is designed for holding the receiver at the ear of the user, and is adaptable to the desk or portable type of telephone. The method of attaching to the telephone comprises removing the transmitter head, and attach-

ing the fixture in the fork formerly supporting the transmitter head, the transmitter head then being placed in a fork carried by the new fixture. A switch replacing the hook switch is carried in the new fixture.

1,050,514. Call Indicator. Barnim L. Behrendt, Newark, N. J. A simple device for showing whether a call bell has been operated since the device was last reset. A drop shutter of a thin slip of metal is held between the tapper and the gong and is released should the tapper move. A hole in the slip of metal at the point between the tapper and the gong assists by its edges to support the shutter, which also is pivoted loosely at its lower end. Such a shutter has two uses. When used at a telephone station it tells the telephone patron after an absence

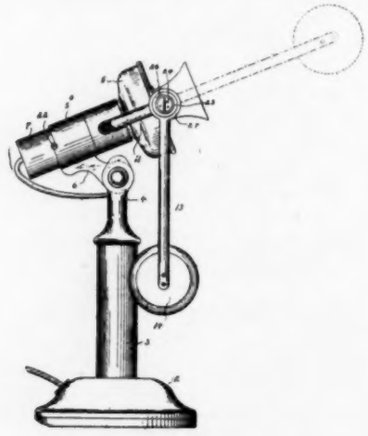


1,050,304.

whether or not the call bell has been rung during his absence. When used upon a "rural line switchboard" where several such devices are mounted, it tells which device was the one actuated, the shutter remaining as a record after the ringing of the signal has ceased.

1,050,520. Key Shelf. E. B. Craft, Hackensack, N. J., assignor to Western Electric Company, New York. The improvement relates to key shelves which are built with a large opening for keys, a supporting metal strip being placed along two sides of the opening, and the key bases being screwed at their ends to the two metal strips, each key base forming a bridge across the opening, and the key bases being placed adjacent to each other to close the opening completely.

1,050,532. Party-Line System. B. C. Groh, Trenton, N. J., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. (The application for this patent was filed in 1904.) The patent discloses a novelty in operating telephone lines. The telephone line shown in the patent is a "magneto" line, having local batteries at each telephone for speech transmission, but the central office operator is enabled to render all of the telephones upon the line unable to receive speech, and therefore unable to talk between or among the stations of the line, while the operator at the same time is enabled to hear all that is said upon the line. This is accomplished by bridging a relay across the speaking elements of each telephone and arranging the points of the relay to shortcircuit the receiver. By

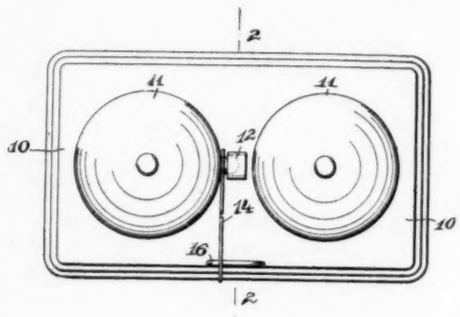


1,050,404.

placing a battery in circuit with the line, the operator is enabled to energize the relays at all the stations which may have the telephones off the hooks. By a key she may release the relays while she speaks to the subscribers. Apparently it was the inventor's thought to give all possible power to the central office operator.

1,050,765. Time Alarm. Philip J. Dell, Jr., Rochelle, Ga., assignor of part to J. N. King, of same place. The general arrangement of this alarm device is that of the "night alarm" circuit of any telephone exchange. During the day the "night" circuit is objectionable because it is ringing constantly with the falling of every signal drop shutter, and therefore it is switched off. Mr. Dell has placed a clock in the alarm circuit in such manner that the alarm will ring only after a lapse of several seconds. The utility of the device for night service is not impaired yet its annoyance during the day is avoided when the switchboard is promptly attended, and "lapses" of the operator's "attention" during the day will be avoided by leaving the alarm device always in circuit.

1,050,797. Antiseptic or Disinfecting Attachment for Telephone Transmitters. Louis Block, New York, N. Y., assignor to L. E. Block, of same place. A device for supporting a pro-

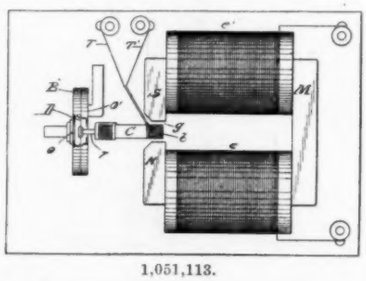


1,050,514.

tector in front of the transmitter mouthpiece.

1,051,109. Telephone Busy-Test System. Elbert R. Hobbs, Buhl, Idaho. In this improved system, a circuit is controlled directly by the subscriber in calling whereby he causes his line terminals to test busy, and another circuit acts through the connecting plugs to cause the line to test busy after connection. By these two circuits, the inventor states, "the active test condition is maintained in absolute continuity from the time the subscriber initiates a call until the final disconnection of his line."

1,051,113. Telephone Receiver. P. L. Jensen and E. S. Pridham, Napa, Calif., assignors to Commercial Wireless and Development Company, San Francisco, Calif. The telephone receiver comprises a pair of magnet spools and a nearly-closed magnetic circuit. The moving element is a small open coil having one side of its convolutions directly in the air gap of the magnetic circuit mentioned. The coil vibrates bodily in a



1,051,113.

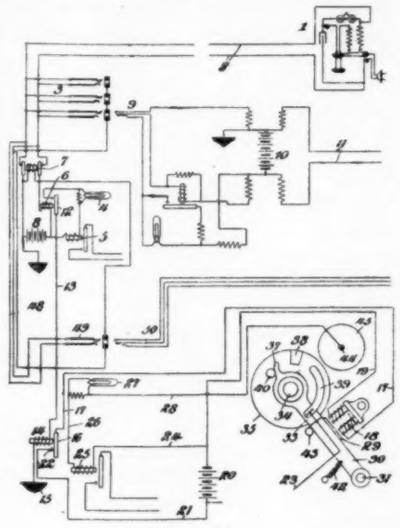
direction perpendicular to its axis, and at right angles to the direction of the lines of force in the magnetic air gap. A diaphragm to produce sound waves is actuated directly by the vibrations of the moving coil.

1,051,148. Selective Signaling System. Judson McFell, Chicago, Ill. This system follows the general lines of that of patent No. 1,048,561, reviewed above. In the system of this later patent, each station has two polarized relays operatively connected with the line wires, and two or even more selectors are controlled in succession over the line by the co-operation of the polarized relays.

1,051,228. Time Signal. Fairbanks C. Hirdler, Oklahoma, Okla. The general nature of the system of this patent is similar to that of the patent No. 1,050,765, reviewed above. Mr. Hirdler has applied his invention to a modern common battery exchange, and shows an arrangement of relay circuits for pro-

ducing the result desired. In the modern large exchange there is a further use for such a timed signal in the circuits between the line-lamp positions and the supervising desks, whereby the lighting of lamps on the supervisory desks may be avoided when the line lamps are answered promptly.

1,051,270. Selective Signaling System. Harry O. Rugh, Sandwich, Ill., assignor to Sandwich Electric Company, of same place. This is a system of step-by-step devices in which the three functions of stepping, ringing and restoration are accomplished by a combination of quick-acting and slow-acting magnets at the telephone station with but a single control circuit from the central office. The stepping magnet is quick-acting and operates rapidly in response to quick current impulses to



1,051,228.

step the selecting arm of the desired station into its required position to close the ringing circuit at that station. The last current impulse is held upon the line and as a result the slow-acting telephone ringer is operated at the desired station and not at any other. The ringer at each station of lower number has had its circuit closed in passing, but not for a sufficient length of time to permit the slow-acting ringer to operate. By holding the lost impulse, too, the slow-acting release magnet at every station is energized and when this last impulse of current finally is broken, all of the selectors are returned to normal, including the one whose ringer was operated. Thus a single series of impulses over a single circuit operates to select, to ring and to restore.

Mechanical Devices in Manual Operating

In ordinary circumstances an operator at a manual telephone exchange has the load of her position so arranged that she is left with a fairly large percentage of unoccupied time in the busy hour; this is necessary to enable her to cope with the traffic during short rush periods. Also during the slack periods, when several positions are coupled, the conditions of operating are such that the load efficiency per position is considerably reduced. Some consideration, therefore, has been given to the feasibility of utilizing automatic equipment in such a manner that when a subscriber lifts his receiver his call will be transferred immediately to an idle operator. By this means it is expected that the percentage of idle operating time in the busy hour will be considerably reduced, and also, as it will be arranged that a position can be rendered inoperative, when not required, the whole of the traffic during slack periods can be thrown on to one or two positions which will be operated with the same efficiency as obtained during the busy hour, said W. Slingo in a recent paper before the British Institution of Electrical Engineers.

The experimental arrangement which will shortly be installed in one of the London exchanges will provide for the replacement of the existing lamps and jacks, individual to the subscribers on each position, by others, say 10 to 20 in number, common to the traffic distributing apparatus. Each position will only be able to receive one call at a time, i. e., while an operator is answering one call one further glow can be received. All further traffic will pass forward to other positions.

The proposal outlined above provides only for the introduction of traffic distributing equipment such as can be readily introduced at an existing exchange, and such as will permit of the continued utilization of the existing cord circuits. If such a scheme proves satisfactory in practice, future installations involving traffic distribution apparatus will be designed on the basis of single cord connecting circuits without answering jacks. The traffic distributor will pass the call direct to the answering side of the cord circuit, and a single operation only will be involved in completing the connection with the subscribers' multiple.

Much difficulty has been experienced during recent years in large cities owing to the poor transmission conditions involved when several underground call wires are connected to the same "B" position. It is proposed to install experimentally a simple automatic call seeking device which will enable one call wire at a time to have access to the "B" operator. It will be arranged so that the "B" operator can trip the apparatus in order that only one call can be passed by a particular exchange before the other exchanges working to the same position have each had an opportunity of passing a call. The "B" operator will be made aware of the necessity for using this tripping apparatus by the glowing of a lamp on her position, which will indicate the fact that an outlying exchange wishes to pass a call. By giving improved transmission it is expected that quicker operating will result, with comparative immunity from "wrong numbers."

On groups of outgoing call-wires between very busy exchanges much trouble has been experienced as a result of—

(*a*) Confusion during busy periods owing to one operator interrupting another in their desire to dispose of the traffic; and

(*b*) Delay experienced by the "A" operators in finding a slack call wire at such periods.

Both these troubles result in reducing the load efficiency of the "A" operator and increasing the liability to "wrong numbers." An automatic call wire selecting equipment has been installed at the Central exchange, London, which has for its object the selection and isolation of a call wire when one is required by an "A" operator. There are 10 call wires in the group affected, and they were, before the introduction of the new conditions, operated from 10 call wire keys, the circuits of which were multiplied over 160 "A" positions. When the selecting equipment was introduced the 10 keys per position were replaced by 1 key per position.

Each operator is given a selector which rotates when she depresses her call wire key. The rotation continues until the wipers find an idle "B' operator, when the "A" operator is able to pass her call. The following are some of the facilities thus obtained:

When an "A" operator depresses her call wire key, she is automatically connected to a disengaged "B" operator.

More than one "A" operator cannot obtain connection with the same "B" operator at the same time.

A click is heard in the "A" operator's receiver when a disengaged call wire is obtained.

During periods when none of the "B" positions are open a calling lamp on the "B" position switchboard glows when any of the call wire keys on the "A" position are depressed. The night bell also rings under these conditions.

Any "B" position is capable of being rendered inaccessible to the "A" operators by throwing a call wire circuit key situated on the "B" operator's keyboard; as, for instance, in cases where the position is closed or when all the junctions terminating on the positions are engaged.

The motor interrupter which supplies driving current to the selectors can be closed down during the period of night working, but will be restarted automatically when a call wire key on an "A" position is depressed, and will continue running until the selector has found and stopped on the contacts corresponding to an accessible and disengaged "B" position, or until the call wire key is released.

An alarm is given when any of the spring sets belonging to the interrupter in use fail to make proper contact. Also in this case a lamp lights, indicating which spring set requires attention.

The experimental equipment has been installed for the British post office by Messrs. Siemens Brothers & Co., Ltd.

Protecting Crops by Telephone

The modern farmer keeps abreast of the times. His farm appliances are those which will enable him to do his farm work in the most efficient manner possible. The old ways of haphazard farming are going rapidly. The farmer is also adapting the rural telephone to his own conditions, some of which are unique even in this day of unusual methods, says *Public Service*.

A novel application of the rural telephone to one phase of farming conditions has been made by a Wood River Orchard Company operating fruit orchards near Weiser, Idaho. It is a well known fact that one night of frost may spoil an entire season's crop. Wood River Company having this in mind decided to take measures whereby they could get ample warning of the approach of frost and make preparations in time to ward off its bad effects on the apple crop.

Thermometers of the dial type are placed in each of the four corners of the valley. On each dial face there is a platinum contact which can be moved to any point on the dial, while another contact point is located on the indicator needle. For orchard use the dial contact point is placed at about 45 degrees Fahrenheit. When the temperature drops to this point, the two contact points come together and close a local circuit. In this local circuit there is an interrupter or pole changer arranged to send an alternating current over wires which connect with a Western Electric No. 1800 sectional unit type switchboard at the main office of the company. This alternating current operates a signal on the switchboard and indicates to the operator that frost is near at hand. As the thermometers are placed at the four cardinal points of the compass it becomes a simple matter to determine from what direction the frost is coming.

The switchboard operator having received the signal calls each of the orchard men who would be affected by the frost. They in turn go through their orchards and light smudge pots which have been installed there at the beginning of the season when frosts are prevalent. The time that elapses from the instant that the thermometer circuit is closed until the last orchard man is notified is not over five or ten minutes at the utmost and much of the fruit crop can be saved in this way where frost would ordinarily play havoc with it.

The present equipment of the switchboard is arranged for twenty lines. When the necessity for more lines presents itself, another unit containing equipment for the additional lines may be added, the switchboard being designed on the sectional unit bookcase plan.

The farmers have found the frost indicator telephone system to be of great value to them, not alone from a protective standpoint, but from the standpoint of freedom from worry. The farmer can go to bed at night during the frost periods with a peaceful mind, assured that his crops are well protected. This affords another illustration of the remarkable adaptability of the telephone to every phase of commercial activity.

Value of Efficiency Advertising

"We cannot say much more than I have said along efficiency lines, but we can point to the fact that advertising changes the habits of the nation. We know it is not much understood, and it has been indicated here and elsewhere in the public prints that its importance is not appreciated. In a Senate report on the 'High Cost of Living,' eager to avoid the tariff and other things, they seized upon advertising as a scapegoat to explain the increasing cost of living. In the annual report of the leather company we find that recently their affairs have not been prosperous and conditions were not good. They do not advertise. But referring to the packing companies, as large and as uncertain and as dependent upon general conditions as the leather company, we find that owing to their advertised by-products their profits have been conserved and they are paying a dividend.

"By advertising we have made a clean nation. The soap publicity has changed the habits of the country. The constant picturing of the bath tub has changed the nation in that respect, because we have trained the public ideal in the direction of bath rooms, sanitary, cleanly and wholesome surroundings. A few years ago in the average town of this country the young man's ideal was to have a good horse, a buggy, and a ten dollar whip; but his clothes were of secondary consideration. Then our tailors started picturing good looking, well dressed young men around the town, and today they have changed the thoughts of young men everywhere, and they wear well recognized brands of clothing. Their care in personal appearance has brought with it self respect in other things. Advertising needs your fostering attention and development in the consideration of the efficiency movement. It is a power for good, a power for practical education and a power for industrial activity."

So writes Mr. Wm. H. Ingersoll in his paper on Advertising, which appears in the first volume of Transactions of the Efficiency Society, Inc., a volume containing matter of great value to all men, no matter what their life's work may be.

Ohio Commission News

The Brownville Farmers' Telephone Company filed a complaint with the Public Service Commission against the Newark Telephone Company, asking that the latter company be compelled to give service connection. It is alleged that agreement had been entered into whereby the Farmers' Company was to receive connection, but that the Newark Company refuses to make the connection.

Telephones Protect Miners

To protect the thousands of miners working in the coal mines the last Oklahoma legislature passed a law requiring all such mines to install telephones. They are to be located every 1,000 feet in the mines and connected to the surface. By this arrangement there will never be a man over 500 feet from a telephone, which, in case of an accident or explosion, will make it possible to get in communication with the surface almost instantly.

Several states have passed such laws, two of the most recent being Kansas and Illinois, both of which have been able to effect the saving of many lives by their use. In Kansas the mine owners require the shot firers, or men who go into the mines after all the miners are out to light the fuses and fire the shots, to report to the surface from every telephone they pass, thus making it possible to keep in touch with their whereabouts at all times.

As evidence of the value of such equipment two shot firers were rescued from a mine located near Girard, Kan., just a few weeks ago. They failed to report to the surface at the proper time, whereupon a rescuing party immediately went into the mine and to the part where they last reported, finding both men overcome by gas. They were taken to the surface, given medical attention and revived within a short time. Without such equipment these men's lives would have been lost.

Such apparatus in mines can be used in many other ways to advantage. For example, a general alarm or danger signal can be sounded that will give notice to vacate the mines at once; or in case of a cave-in the entombed men can communicate with the surface, advising their location. Furthermore, they can be used in an economical manner in the operation of the mines and many other ways that would not only be beneficial to the miners, but to the mine owners as well.

Such telephones, so as to withstand the severe conditions encountered in underground work, must be of special construction and so designed as to withstand the moisture, injurious gases, acids and rough usage to which they will naturally be subjected.

So beneficial and practical have they proven where installed it is predicted it will be but a short time until all mines in this country will be so equipped.

Bonuses for Loyal Employes

Telephone operators, supervisors, chief operators, matrons, clerks and former employees who remained at their posts throughout the telephone operators' strike at St. Louis which ended a few weeks ago, will receive a bonus of $25 each. The announcement was posted in the various exchanges as a surprise. Officials said the payments would require some time, but it was hoped all bonuses would be distributed by September 1.

More than 800 will get the $25 bonus and former employees, who worked after the beginning of the strike, will be paid a bonus of $2.50 a week for each week they worked till the close of the strike. The following schedule was published by the company:

1. Twenty-five dollars to all operators, supervisors, chief operators, matrons and clerks who were on the pay roll June 16, 1913, and who remained on duty during the entire trouble, being still on duty on August 5.

2. Twenty-five dollars to all former employees working before June 24, and who remained on duty up to and including August 5.

3. Two dollars and fifty cents per week for each week worked between June 24 and August 5 to all former operators who were employed after June 24, provided they remained on duty up to and including August 5.

In announcing the awards the company also declares that in addition to being strike bonuses they are intended as compensations for the heavy work performed by the operators during the three-day holiday season, July 4, 5 and 6, when the heaviest business in the history of the city was done during extremely hot weather.

The new Colfax exchange has been opened. Thirty operators will be employed in the new exchange.

Although the strike of maintenance men and operators was settled, the cables of the company in Granite City have been cut about five times since the official declaring off of the strike.

One cable was cut within six hours after the actual settlement of the strike and several more were cut following the refusal of the telephone company to employ only union telephone operators in the Granite City Exchange.

Checking Telephone Instructions by Dictaphone

The saving of time and the general convenience obtained by the introduction of the telephone have been somewhat offset by the difficulty of proving that any particular order has been given by this means. Especially is this so in the case of railway working where train dispatching by telephone has been adopted, and where the omission of a small word may lead to fatal accidents. There appears to be no difficulty in the arrangement adopted to remedy this defect by the South-West Missouri Railroad, where, according to the *Electric Railway Journal*, since March 1 of this year the ordinary standard type of telephone in the train dispatcher's office has, by means of a Y branch adapted to the transmitter mouth-piece, been coupled by a length of flexible tube to the standard type of dictaphone. The drum of this instrument, being electrically driven, can be brought into operation by the switch hook of the telephone receiver. Every order given to the train men by the dispatcher is now recorded by the distaphone, to which reference may be made in any event of dispute or misunderstanding. The wax records, which have an effective capacity of over 2,000 words, are kept for a period of three days, when they are "shaved" and put back into service, for which process they are available 150 times. This, it is said, is the first application of the dictaphone to this particular work, for which it has proved to be perfectly adequate.

Telephone Man's Tribute to Girls

A. L. Tetu, formerly general manager of the Indianapolis Telephone Company and known as "the friend of the telephone girl," left Indianapolis in 1907 to become manager of the Home Telephone Company at Portland, Ore., but he is now engaged in the real estate business. He visited the offices of the Indianapolis Telephone Company recently and called on friends.

"Although no longer connected with the telephone business, I am still interested in the welfare of the telephone girls," he said at the Claypool. "I still maintain what I have always held, that no class of employees exhibit a greater fidelity to duty than the telephone operators. The ordinary patrons have no conception of the average operator as she is. They regard her as a gum-chewing, gossiping, careless creature who is responsible for all the delays and faults in the service. As a matter

of fact, no operator in a first-class exchange could be like that and hold her position very long. The discipline in a well-regulated telephone exchange is strict and no operator would be permitted to do much loafing or eavesdropping even if she were so inclined. If I had a daughter or a sister who had to earn her living, there is no place I would rather see her go to work than in a telephone exchange."

Chicago Sale Fought by Users

The Telephone Users' Association, an organization whose membership is being drawn principally from automatic telephone subscribers in Chicago, is being formed for the purpose of protesting against the proposed sale of the automatic telephone system to the American Telephone & Telegraph Company. Such a sale, according to those back of the organization, means the death of the automatic telephone in Chicago.

The Automatic Telephone Company gives the Inter-State Company toll connections with Chicago.

"Though the American Telephone & Telegraph Company controls 90 per cent of the stock of the Chicago Telephone Company, it has no franchise in Chicago and it would have no interest in continuing automatic telephone service," said Harold Stroud, one of the prime movers in the new organization.

"Such a sale would mean the end of the automatic telephone in Chicago. If the automatic system must be sold, we wish to see it sold direct to the Chicago Telephone Company itself, with proper provisions for its continuance."

Interstate Commission Orders Statements

The Interstate Commerce Commission has ordered all common carrier telephone companies to furnish, by October 1, a detailed statement of their organization, equipment, physical and financial operations. This is the first order of the commission since the formal bringing of the investigation into the relations and affairs of these companies. Already the inquiry has been extensive. Special agents of the commission have gathered an immense amount of data bearing upon the operation of telephone companies. As soon as practicable, the commission will hold in various parts of the country public hearings, at which testimony will be taken as to the rates and operating methods of such companies as come within its jurisdiction.

8,000,000 Mark Passed by American

The American Telephone and Telegraph Company has been making its usual steady gain in stations so far during 1913. If the rate of growth achieved during the six months to June 30, the first half of the fiscal year, continues during the full twelve months the company will have on December 31 next a total of 8,200,000 owned and connected stations, the first time that its station total has crossed the 8,000,000 mark.

For the six months to June 30 there was a gain in Bell-owned stations of about 250,000 and in stations of connecting companies of 120,000, making the actual addition to the service scope of the Bell wires 370,000 stations, a figure which compares with a gain of 322,000 stations during the first half of 1912.

Every section of the country has been showing about the gain anticipated when preliminary estimates of station growth were made up on January 1.

As of July 1 the total number of stations owned and operated by the Bell companies in the United States was approximately 5,200,000, against 4,953,447 on December 31 last. The number of stations owned by other companies but connected to and exchanging service with the Bell system was about 2,600,000, making the station aggregate 7,800,000.

Shop Talk Barred at Picnic

All mention of telephones was barred at the annual outing of the Minneapolis and St. Paul Tri-State Telephone Company's employees, under pain of a ducking in Lake Minnetonka and so satisfying was the relief to the operators and other employees that the ducking stool was not once used.

While a small force of operators at the stations did triple work, with the co-operation of subscribers, who had been asked to be patient, the others went to Spring Park for the day. As soon as the forces arrived at the park the mechanics of the two plants rigged up a ducking stool and explained that the first person who talked shop was to be ducked. Then the festivities went on without interruption.

St. Paul employees carried off the two ball games, the regular game and the kitten ball contest, but the running races and other contests were evenly divided.

The dancing pavilion was chartered for the day and was used as a headquarters. After the luncheon and dinner were served and the games were over a string orchestra went out on a late train and furnished music for the dancing.

The only sad moment was when the dancing began, as half of the girls who had spent the day at the lake had to return to relieve those who had remained on duty all day.

Railway Board Looks Into Service

Thomas McCormick, inspector for the Michigan Railway Commission, is conducting an investigation of Detroit's telephone service, as a result of numerous protests to the state commission by local telephone subscribers. The investigation was begun by making scores of calls of all natures and using a stop watch to time them. Numerous other tests will be applied in an effort to find every kind of trouble that exists, as well as remedies therefor.

General Manager Von Schlegell, of the Michigan State Telephone Company, says the company welcomes the investigation by the state commission, which has power to regulate telephone companies. He expects a call from the inspectors and says that the whole system will be completely opened to their scrutiny. The company, he says, recently appropriated $800,000 for improvements during the year and these are being made as rapidly as possible to take care of the present overload.

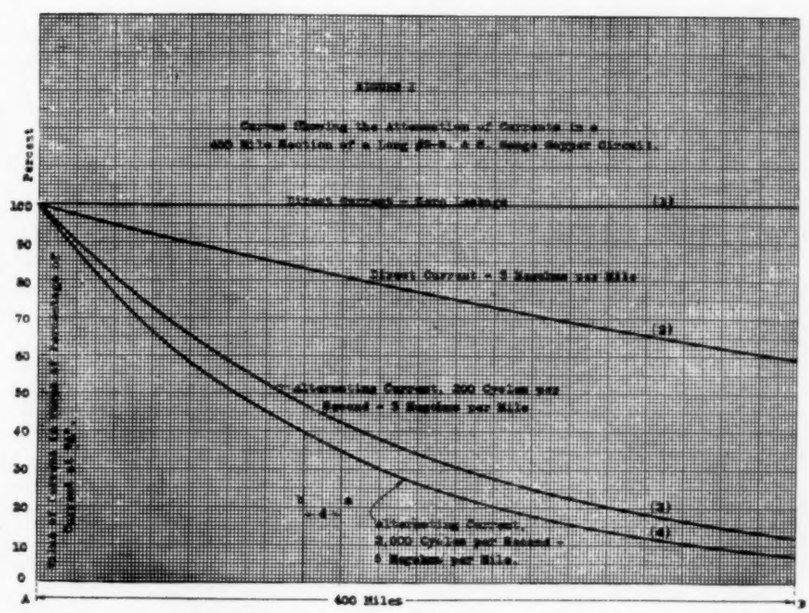
In the early stages of telephone construction in New South Wales, some 300 lines were erected by private users before the Australian Government assumed control of the system, and the owners of these lines were granted the right in perpetuity to retain them on payment of $5 per annum. An act was passed in 1911 to empower the government to resume the lines on payment of compensation, to be settled by arbitration, and these powers are now being enforced, greatly to the annoyance of some 250 firms that will be affected.

DEPARTMENT OF RAILWAY TELEPHONES

Facts Concerning Telephone Transmission

By Elam Miller and C. A. Robinson*

TELEPHONE transmission is essentially an alternating current problem, not, however, a problem similar to the usual problem of alternating current power transmission, for which the energy involved is large and for which frequency of the currents to be transmitted is low (from 25 to 60 cycles per second) and where it is desired to transmit currents of one frequency only, but a problem involving very small amounts of energy and combinations of current frequencies ranging from 200 cycles per second up to possibly 2,000 cycles per second.



In the simplest case a telephone circuit consists of a pair of uniform conductors with a transmitting station at one end and a receiving station at the other. The transmitter diaphragm at the sending end is caused to vibrate by the air vibrations excited by the vocal organs of the speaker. The system of mechanical vibrations here set up and subsequently converted into electrical vibrations is extremely complex. They vary in frequency considerably beyond the limits previously given, but fortunately, in order to reproduce intelligible speech, it is not necessary to consider frequencies much above the upper limits or 2,000 cycles per second. The diaphragm of the transmitting apparatus responds more readily to some frequencies than to others, which introduces a source of distortion. In addition to this, telephone currents are again distorted by the line itself, in being transmitted from the sending to the receiving station, and the diaphragm at the receiving station again responds more readily to certain frequencies than to others. With well-designed telephone apparatus and within the limits over which it is possible to transmit sufficient energy to give audible volume, distortion is not the controlling factor, but rather the limitations of telephone transmission are fixed by the question of the actual amount of energy that reaches the apparatus at the receiving end.

The amount of energy available for the transmission of telephone currents is extremely small, and with the best de-

Department of Railway Telephones

This department is established as a permanent feature of TELEPHONE ENGINEER. The progress of the art of telephone train dispatching, its technical development, its news, and the elucidation of its mysteries for the non-technical worker will be found each month in these pages. The editors invite the problems and solicit the co-operation of the many readers of TELEPHONE ENGINEER in all parts of the world whose interests lie along these lines.

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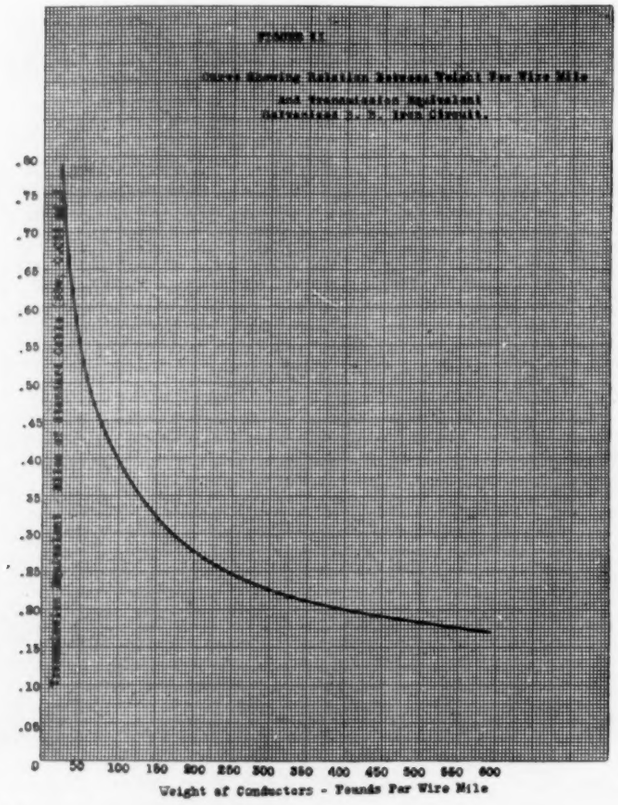
vices for all-around general use, which it has been possible to construct for transforming the sound energy into electrical energy, it is possible to impress upon the sending end of a telephone line not more than 3 to 5 volts. This means for certain types of telephone lines in common use outgoing currents of the order of three-thousandths to five-thousandths of an ampere; and when it is realized, as will appear later, with what rapidity the current decays as the wave travels along the line, it will be apparent that the amount of current which reaches the receiver at the distant end of a long line is extremely small. A line which permits 10 per cent of the outgoing current to reach the distant end will give excellent transmission. This would correspond to a received current of from three to five ten-thousandths of an ampere.



Under favorable conditions it is possible to carry on conversation over a line which permits but 1 per cent of the outgoing current to reach the distant end. This would correspond to a received current of the order of three to five one-hundred-thousandths of an ampere, or 30 to 50 micro-amperes.

Loss in Line Circuits.—If we apply a direct current voltage between one end of a perfectly insulated line wire and ground, the other end of the line wire being connected to ground through, say, telegraph apparatus, we obtain, as soon as sufficient time has elapsed to establish the steady state, the same value of current in all parts of the circuit. Suppose, now, the line, instead of being perfectly insulated, were uniformly leaky, such, for example, as an open wire supported at regular intervals on insulators; it is apparent that now some of the outgoing current will return through ground at the first insulator, some more at the second insulator, and so on, all along the line, with the result that the current, instead of being the same in all parts of the circuit, will diminish regularly in strength from the end at which the potential is applied, to the distant end. It is apparent in this case that the relation between the currents at any two points on the line depends upon the resistance of the wire and the leakage from wire to ground. This condition approximates the simple telegraph case if we consider such speeds as are attained in hand sending.

In considering the case where the applied voltage is alternating instead of direct the resistance and leakage, though still two of the factors which enter into the determination of the relation between the currents at any two points in the line, do not comprise all of the factors involved. In the alternating current case there are two more very important characteristics; namely, the capacity and inductance of the line. Suppose that, instead of considering this alternating potential applied between wire and ground, we consider it applied between two uniform conductors by the telephone transmitting apparatus, and we have the simple telephone case.

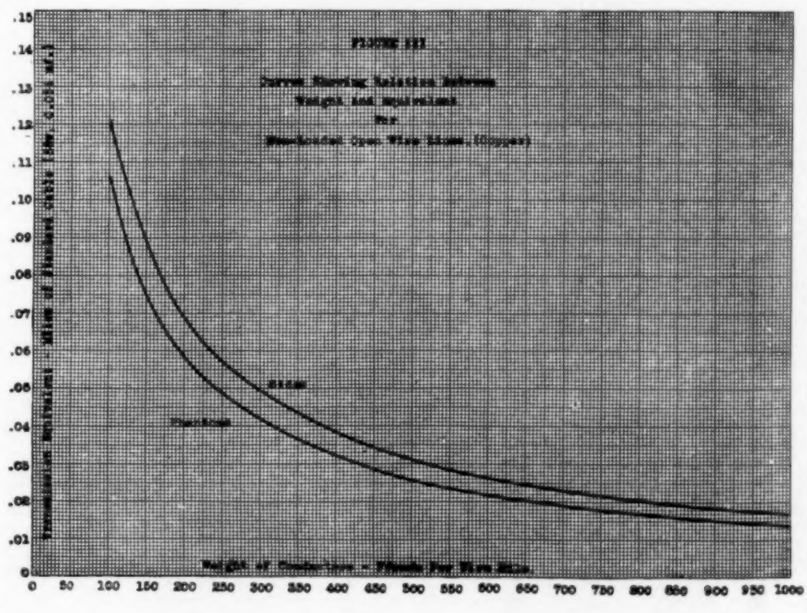
In order to give some idea of the relative rates of loss of current, or current attenuation, for a direct current and an alternating current condition, a diagram (Fig. 1) has been prepared which refers to a metallic circuit consisting of a pair of copper wires, weighing 210 pounds per wire mile, and strung on 12-inch centers. Assuming a very long line of this construction, in order that end effects may be neglected, let the current at a certain point *A* in it be represented by unity; and suppose the point *B* to be 400 miles distant from the point *A*. With a direct voltage as the source of current, the relative magnitudes of the currents at all points between *A* and *B* are as shown on curves *1* and *2*, the line leakage being assumed 0 for curve *1*, and 5 megohms per mile for curve *2*. Curves *3* and *4* show the relative currents for all points along the 400 miles of line with alternating voltages of frequencies of 200 and 2,000 cycles per second, respectively, as the sources of current, the line insulation being assumed as 5 megohms per mile. Curves *3* and *4* represent telephonic conditions.

While the frequencies of voice currents vary over considerable ranges, it has been found, by checking computation with experiment, that a fairly close approximation to the rate of decay of current in a telephone circuit can be obtained by computing the loss which would occur if the current were of a single frequency of about 800 cycles per second. The curve for 800 cycles per second is not shown on the diagram (Fig. 1), but it would lie between the curves for 200 and 2,000 cycles and, for the purposes of this discussion, may be assumed to be practically coincident with the curve for 2,000 cycles.

One reason for plotting the curves on Fig. 1 has been to bring out the great difference between the rate of decay of a telephone current and a telegraph current. It is seen that starting at any point in the line, with the telegraph current represented by unity, we have, after traversing 400 miles of the type of line under consideration, about 60 per cent of the initial current; whereas, for the telephone current in the same line, we have about 7 per cent (compare curves *2* and *4*).

There is another important difference between the telegraph and telephone cases, namely: that, whereas, with the telegraph, one can, by increasing the voltage, largely increase the outgoing energy in order to compensate for low efficiency of transmission on the line, no such expedient can be resorted to in the case of the telephone, for several reasons.

With particular reference, now, to the telephone case, and considering again Fig. 1, curve *4*, suppose we select at any point along this curve two ordinates at a distance *d* miles apart, and let the length of the longer ordinate be represented by *b* and that of the shorter ordinate by *a*. If the distance *d* is always kept at the same value, it will be found that the ratio a/b is constant, no matter which section of the curve is considered. The physical meaning of this is that starting at any point of a particular type of line with a single frequency alternating current, the amplitude of the current, after it has traversed a given distance from the arbitrarily selected reference point, is always of the same percentage value of the amplitude of the current at the reference point, regardless of whether the section of line considered is near the transmitting end or near the receiving end. In other words, for a given length of uniform line the loss is always the same. For purposes of convenience and for use in expressing the transmission efficiency of various classes of circuits, standard No. 19 B. & S. gauge paper insulated cable, having 88 ohms resistance per loop mile and a mutual capacity of .054 microfarads per mile, has been chosen as the unit of measure. With cable having these constants, the amplitude of an 800-cycle alternating current would be decreased, roughly, by about 10 per cent after having traversed one mile of the cable. If, then, with any other type of construction, it is necessary for current of this same frequency to traverse, say, 10 miles before its amplitude is reduced 10 per cent, then one mile of this second type of construction would cause only the same transmission loss as one-tenth of a mile of the standard cable; or, 100 miles of this second type of construction would cause a loss equal to that produced by 10 miles of the standard cable.



In using this mile of standard cable as a unit of measure, a standard circuit has been adopted and the transmission efficiency of a telephone circuit, including the substation sets at the ends, is completely determined by comparing it to the standard arrangement commonly called the "standard circuit." This standard circuit consists of a variable length of artificial standard No. 19 gauge cable, having the constants previously mentioned, with a standard common battery substation set connected through a No. 25-A repeating coil and 24-volt battery directly to each end. The number of miles of this artificial cable which has to be placed in the standard circuits in order that it shall give the same transmission as the circuit being measured, is then stated to be the transmission equivalent of this circuit, and, for a given volume of speech at the sending end, the volume of the received speech will be the same for the circuits being measured as for the standard circuit.

Figs. II, III and IV show, respectively, the transmission efficiency of open wire iron circuits, open wire copper circuits, and paper insulated cable circuits. These curves are plotted with weights of circuit per wire mile against transmission efficiency in terms of standard cable, and, for open wire copper circuits and paper insulated cable circuits, give value for both physical and phantom arrangements. A comparison of the cable curves on Fig. IV with Fig. III for open wire copper circuits, shows clearly the effect of high capacity and negligible inductance in the cable circuits as compared with the relatively low capacity and the relatively high inductance inherent to open wire circuits.

In addition to the transmission values given in Figs. II, III and IV, there are values for two other grades of conductors that may be useful. The ordinary type of outside distributing wire, which is made up of rubber insulated No. 14 B. & S. gauge copper, has an equivalent per mile of 0.8 mile of standard cable, and the ordinary type of No. 18 B. & S. gauge bridle copper wire has an equivalent of 1.6 miles of standard cable.

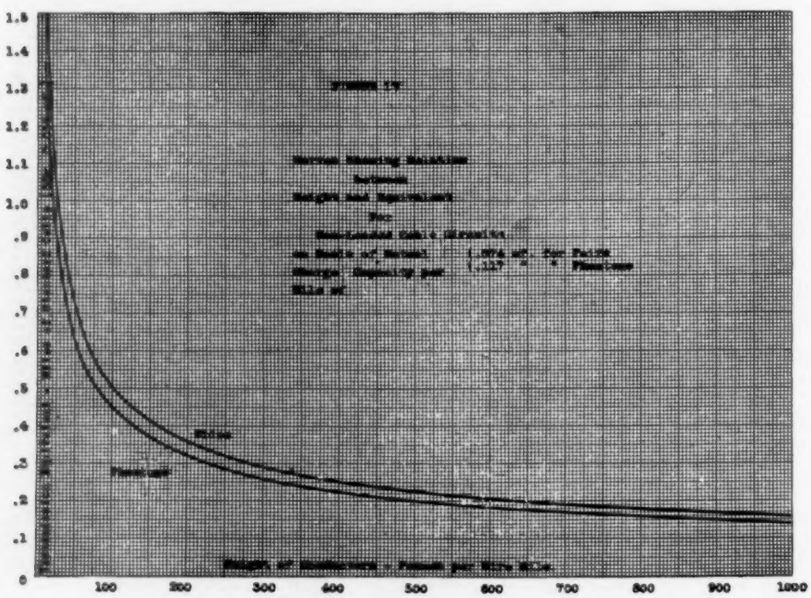
Rubber insulated cable is being used less and less for telephone work and its equivalents are not included here. For telephone purposes rubber insulated cable, due to its excessively high capacity, is very inefficient. The transmission equivalent of any particular type of rubber cable can, however, be approximately determined as follows:

$$a=\sqrt{\frac{RC}{R_1 C_1}}$$

where R and C are the loop resistance per mile and the mutual capacity per mile, respectively, of the rubber cable, and $R1$ and $C1$ are the resistance per loop mile and the mutual capacity per loop mile, respect-

ively, of standard cable. *a/* is the equivalent per mile of rubber cable in terms of miles of the standard cable. This same equation is also applicable to paper insulated cable and may be used for determining the difference in efficiency due to the variation in capacity.

Switchboard and Apparatus Losses.—In what has previously been said, we have discussed losses with particular reference to attenuation in the telephone line or trunk. The attenuation in the telephone line or trunk by no means comprises all the losses that are incurred between the sending and receiving end of a telephone circuit, whether this telephone circuit be one used by a commercial telephone company or a telephone circuit for any other purpose, other, possibly, than a private telephone line having nothing connected to it but a sending and receiving station. Telephone circuits, in general, do not consist simply of a pair of telephone instruments connected by a telephone line, but intermediate between the two instruments and for the purpose of making the circuit a portion of a general system, connecting and signaling apparatus must be introduced. Further, many telephone lines have connected to them bridged stations and frequently, also, are used for simultaneous telephone and telegraph purposes. This latter use is quite common to railroad telephone lines. The fundamental facts to be borne in mind in regard to the transmission effect of apparatus which may be connected to a telephone line, are that



1: Generally speaking, any series or bridged apparatus connected to the telephone line introduces a loss; and

2: In general, bridged losses are large when the impedence of the bridge is low and series losses are large when the impedance of the series apparatus is high. These losses are measured in terms of miles of standard cable just as various types of line circuits are compared to standard cable to determine their transmission efficiency.

In view of the facts just stated, it is apparent, of course, that the amount of series or bridged apparatus connected to a circuit should be limited to that which is really needed for the proper operation of the circuit, and that this apparatus should be so designed as to cause minimum transmission losses whether the apparatus is for series connection or is to be bridged across the circuit. One of the most common causes of relatively large and, in many cases, unnecessary transmission losses is that low impedance drops are bridged on long distance circuits either on the long distance line or trunk itself, or on the connecting cords, and that in many of the cases the line drops as well as the cord circuit drops are left on the circuits while the circuits are in use. The importance of this particular source of loss and the necessity for reducing such losses to a minimum may be realized when it is stated that the loss of each bridged drop, which is not intended to be left upon the circuit when in talking condition, may introduce a loss of as much as a mile of standard cable.

As a further illustration of the magnitude of the losses which are introduced by some of the most frequently used types of switchboard equipment, some of the values are given below:

	Transmission equivalent, miles of standard cable
1 mile of No. 22 B. & S. silk and cotton insulated switchboard cable	2.2
1 mile of No. 19 B. & S. silk and cotton insulated switchboard cable	1.7
6-ft. 2-conductor steel cord	.25
6-ft. 2-conductor tinsel cord	.03
118-A relay in series connection	.35
No. 25-A repeating coil	.5

Excessive transmission losses are also caused when operators cut in on a circuit with the usual form of operators' telephone set equipment. For the usual types of sets these losses vary from 3.7 miles to 0.2 mile, depending on the type of the operator's set. It is at once apparent, therefore, that not only should the operator's set be specially designed to cause but a relatively small transmission loss when it is necessary for her to cut in on a circuit for monitoring purposes, but it is essential that the discipline of the operators be such that they will go in on the circuit only when there is a real need for it.

From what has been stated regarding losses caused by series or bridged apparatus, it is evident, also, that every additional use to which a pair of wires is placed involves the installatoin of additional apparatus in the talking circuit, and very frequently, particularly if the best apparatus for the purpose is not used, in an effort to use a pair of wires for more than can properly be gotten out of them, they become so burdened with equipment that the telephone transmission becomes all but uncommercial. As an indication of the magnitude of the losses which may be brought in even for the usual simultaneous uses to which a pair of wires are put, a few definite transmission losses are given below:

	Transmission equivalent, miles of standard cable	
	To Phantoms	To Physicals
Each 37-A phantom repeating coil	.25	1.5
Each 37B phantom repeating coil	.05	.25
Standard composite sets	1.0	1.5

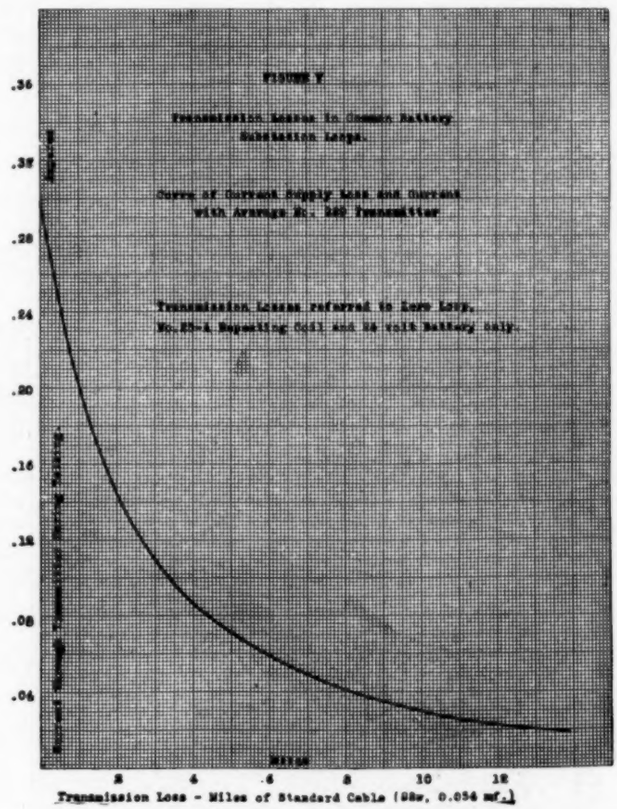
Note.—The losses just given for composite sets include the composite equivalent at two ends of the circuit. The loss of one mile under the phantom column is on the basis that both side circuits and not the phantom itself are composited.

Substation Loop Losses.—Another source of loss is in the substation loop or line connecting the substation to the central office switching apparatus. The two general types of substation equipment are the so-called "common battery" and "local battery" types. These designations define the methods employed for feeding current to the transmitter. No attempt will be made to go into detail as to the proper field of usefulness for the two types of instruments, but simply to indicate the nature and magnitudes of the losses for the two cases.

The common battery instrument is the one used in the standard circuit, to which reference has previously been made. With this type of instrument, as the name applies, current for operating the transmitter is supplied from the central switchboard, to which all the substation instruments are connected by so-called subscribers' loops. In a common battery loop allowance has to be made both for the attenuation of the loop and for the current supply, these losses, in any case, being the losses in excess of those obtained with the standard circuit which is the basis of reference. In the standard circuit the length of loop connecting the transmitting set and the source of current supply is O. In so far as the attenuation loss of a common battery loop is concerned, for length of loop other than O, this can be taken as the attenuation over that length of whatever type of circuit the loop is composed. The resistance in the standard circuit consists, simply, of the battery supply coil, one winding of the induction coil in the transmitting set, and the transmitter button. Any resistance, therefore, in the loop, in excess of that included in the standard circuit, will decrease the magnitude of the current which can flow through the transmitter and thus introduce a current supply loss in excess of that of the standard circuit. The magnitude of this current supply loss for the standard Western Electric Company's instrument equipped with a No. 229 transmitter, is shown in Fig. V, where current through the transmitter during talking is plotted against the transmission loss in terms of miles of standard cable.

With the local battery set, each transmitter has its own separate source of battery supply, and usually the battery circuit consists only of the battery, the transmitter, and one winding of an induction coil. The set is therefore not dependent upon receiving any transmitter current from the central office for its proper operation, and the losses in this set, beyond the losses assumed in the standard circuit, consist only of the attenuation loss in the loop connecting it to the central office; that is, assuming that the local batteries are in standard condition. Deterioration of the local batteries, of course, immediately introduces loss. A standard Western Electric Company local battery set equipped with 4 dry cells in average condition has the same transmission as the standard 24-volt common battery set as used in the standard transmission circuit. As with the ordinary standard local battery sets, different numbers of dry cells are sometimes employed, Fig. VI has been prepared to show the relation between the voltage across the transmitter when talking and the transmission loss for the standard local battery set of the Western Electric Company equipped with a No. 229 transmitter.

Figs. V and VI give the transmission losses dependent upon current supply for the ordinary standard type of common battery and local battery instruments usually employed for commercial telephone service. For certain special forms of service, such as train dispatching by telephone, so-called loud-speaking instruments are needed in order that satisfactory transmission may be furnished to a large number of stations bridged across one circuit. The energy impressed on the line by a train dispatcher's set is greater than that which is sent out by a regular standard set, by an amount varying from 5 to 10 miles of standard cable. In these cases the substation circuits

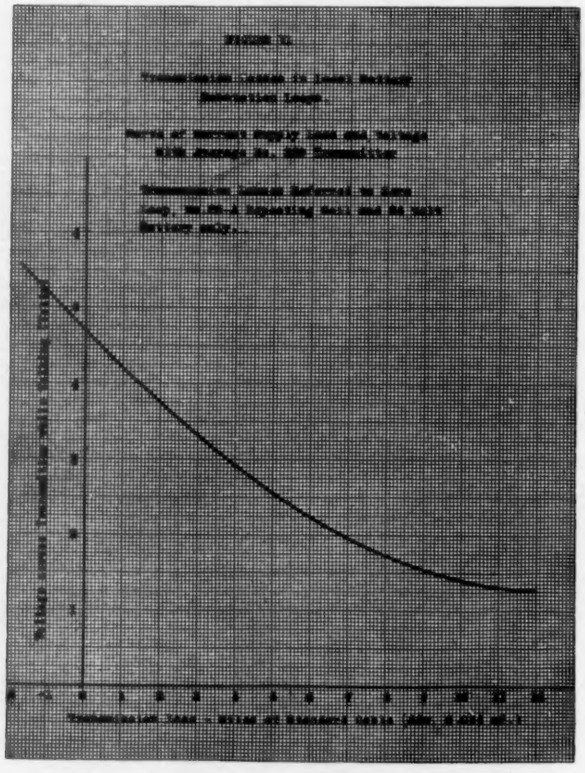


are usually special, and in practically every case special transmitters are employed.

Grades of Transmission.—It must of course be obvious that different grades of transmission are required for different classes of service; that is, the volume of received speech for certain classes of service may well be different than for certain other classes. For instance, it has been found that for local service in a commercial telephone exchange, where the use of the telephone is great and the needs of the public exacting, a grade of transmission of from 18 to 22 miles of standard cable from substation to substation frequently works out very satisfactorily. On the other hand, experience has indicated that for the bulk of long distance service, transmission very much lower in grade than this is entirely satisfactory. Many commercial long distance lines are designed to provide a grade of transmission between substations in the neighborhood of 30 miles of standard cable.

The transmission requirements in railroad work are decidedly different from those in a commercial telephone company. However, a grade of transmission equivalent to 18 miles should be entirely satisfactory to permit of the passing of train orders on dispatching circuits without any mental strain on the part of the listeners, and without any unnecessary repetition on the part of the speaker. For regular talking circuits as normally operated by railroad companies it would seem that a 30-mile transmission between telephone stations should prove satisfactory. In any particular case, however, either of train dispatching service or of talking circuit service, those familiar with the requirements of the service must fix the transmission standards.

Interference.—Up to this point we have discussed only sources of energy loss that enter to reduce the volume of received speech. However, in order that telephone service may be commercial, there is another important matter that must be given consideration,



and that is the question of extraneous current which may manifest itself as either cross-talk or noise. Cross-talk is the overhearing that may result when an unsymmetrical arrangement of telephone circuits occurs in the same immediate neighborhood. Noise may be the result of telegraph or power circuit induction, or the combined cross-talk effect of many telephone circuits.

Any extraneous current flowing in a telephone circuit which finds its way through the receiver produces an effect which tends to render more difficult the receiving of voice currents over that circuit. It is possible to determine experimentally the effect of this interference in terms of the amount of standard cable which will interfere with receiving to the same extent as the extraneous current. The effect of extraneous current on receiving varies between quite wide ranges, depending on the frequency of the extraneous currents, the effect for high frequency being much more pronounced than that for low frequency, between the ranges of from 60 cycles to possibly 800 cycles. As an example of the effect of superimposed current on receiving, suppose we start with a circuit having an equivalent of say 25 miles of standard cable and pass through the receiver at the listening station 10 microamperes of current having a frequency of 300 cycles per second. This very small amount of extraneous current renders it as difficult to receive over a circuit having an equivalent of 25 miles of standard cable as over a circuit composed of approximately 29 miles of standard cable without the extraneous current; in other words, the interference caused by this current is the equivalent of adding to the circuit approximately 4 miles of standard cable.

It is important that it be recognized that it is just as essential that telephone circuits be free from extraneous current above certain limits as that their make-up be such that the attenuation does not exceed certain limits. With this in view and with particular reference to the matter of cross-talk, a very comprehensive and effective transposition system has been devised for telephone circuits on the same pole lead. This transposition system, usually spoken of as a system of cross-talk transpositions, is not designed to be effective against extraneous sources of inductive trouble such as paralleling power leads. The question of power induction, however, is not a matter that will be discussed in this paper, as it is being very ably handled by Mr. Howe of the Western Union Company.* Such references, therefore, as are made to the matter of power induction will be made but incidentally in connection with insulation and maintenance matters.

As to cross-talk, the telephone transposition systems which are in general use give entirely satisfactory results when regular commercial forms of telephone substation equipment are employed on the different circuits. It is very probable, however, that the present standard transposition schemes will not be satisfactory in all cases where loud-speaking instruments, such as are normally employed for train dispatching, are used in impressing a much greater amount of energy on the line than is the case with regular commercial instruments. While, therefore, it may be that no serious difficulties have been experienced from cross-talk on open wire lines up to the present time, it is very likely that this is because the dispatching and message circuits, on which the loud-speaking instruments are used, have been more or less isolated from other telephone circuits and from each other. The general tendency at this time seems to be to use train dispatching circuits and message circuits as side circuits of phantoms and to employ the phantoms as regular talking circuits. This may mean that in such cases new transposition schemes will have to be devised to decrease the length of exposures between the various circuits, especially the exposures between the phantoms and their own side circuits, and in this way to prevent the cross-talk from being excessive when loud-speaking instruments are employed.

*See Telephone Engineer for July, 1913, page 41.

Regardless of the nature of the substation instruments which are used, cross-talk difficulties are often experienced, due to the fact that the transposition systems are not properly applied. This is the case, especially in connection with dispatching and message circuits, in that numerous bridged stations on such circuits are usually located indiscriminately in so far as the transposition schemes are concerned. In the most commonly used transposition systems a unit length of 8 miles is taken and the design of the systems is such that in this length each circuit on a 40-wire line is relatively transposed with respect to every other circuit, the transpositions being so devised that the maximum transposition or minimum exposure effect exists between adjacent circuits. For long stretches of line an 8-mile transposition unit is satisfactory and is normally employed, but to meet special cases, transposition schemes have been worked out for units of less than 8 miles, the schemes as designed being such that no matter whether any particular length of line is as little as ½ mile or as much as 8 miles. It may be properly transposed in one unit with the proper transposition balance between all the circuits on a 40-wire lead. Generally speaking, in order that the cross-talk between any two circuits may be well within commercial limits, no irregularities of any kind should be introduced in these circuits at an intermediate point in any transposition unit and any bridged stations which it is necessary to place on the circuits should be located at the junction points of adjacent unit transposition sections. When located in this manner, these irregularities do not unbalance the cross-talk system.

What has just been said has particular reference to the bridging of stations on train dispatching and message circuits, especially when it is desired to use the message circuit and the train dispatching circuit as the side circuits of a phantom, which, in turn, is to be used as a regular talking circuit. Each bridged station on a message or dispatching circuit should be placed at the junction point of two of the unit transposition sections. For example, if the first bridged station occurs six miles out from the beginning of the line and the next bridged station comes three miles beyond that point, with the succeeding one five miles beyond that, and so on, the first six miles of line should be made one complete transposition unit, the next three miles another complete transposition unit, and the next five miles another complete transposition unit. With the transpositions carefully laid out in accordance with the above outlined procedure, it is believed that no serious cross-talk difficulties should be experienced even in cases where message and dispatching circuits are used as the side circuits of phantoms, and where loud-speaking instruments are used on the message and dispatching circuits.

With further reference to the question of cross-talk between a phantom and its two side circuits, it is to be noted that not only is it essential that a transposition scheme giving a proper balance of exposures be used and that bridged stations be located at neutral points in the transposition scheme, but it is very essential, also, that the two wires making up each side circuit be balanced electrically both in regard to series resistance and in regard to insulation unbalances or capacity unbalances between the two wires of the pair and ground or other outside systems. When it is realized that a series resistance unbalance between the two wires, making up a side circuit of a phantom amounting to from 10 to 20 ohms, will cause cross-talk between the phantom and that side circuit, which would be entirely uncommercial, the importance of what has just been stated is apparent. Trouble of this kind can very readily occur due to careless work on the part of the linemen in repairing breaks by making hand joints in the wires, or even when sleeves are used by not properly cleaning the wires before making the sleeve joint. It is not unusual, in running down noise and cross-talk troubles, to finally locate the source of trouble in one or more sleeve joints having a resistance as large as 25 ohms each. In regard to capacity unbalances, if the wires are properly transposed in accordance with a definite transposition system, no trouble from this source should be experienced. In regard to insulation unbalances, however, this is a condition which may creep in especially at bridling and cabling points unless the question of line maintenance is properly followed up and the circuits maintained up to a high standard at all times.

Proper maintenance of the outside circuits is, in fact, one of the first essentials of satisfactory telephone service over long distance circuits not only from the standpoint of cross-talk between a phantom and its side circuits or between different physical circuits as outlined above, but also from the standpoint of noise introduced from adjacent power or telegraph circuits. No matter how well transposed against power and telegraph circuits telephone circuits may be, if the circuits are unbalanced due to poor insulation and poor maintenance conditions, any transpositions which may have been put in especially for the purpose of reducing the effect of the disturbing sources, will be largely ineffective, and the particular noise introduced into the telephone circuits may be as much or more than if no transposition had been placed.

Maintenance.—Several references have already been made to the maintenance of the telephone lines. Proper maintenance of the telephone plant, both of the substation and switchboard apparatus and of the outside lines, is essential to satisfactory transmission and the general reliability of the service. Proper maintenance consists in maintaining the plant up to its initial standard of efficiency. As far as the substation and switchboard are concerned this resolves itself largely into a question of knowing at all times that the various pieces of apparatus are functioning properly and in case any of the apparatus becomes defective and has to be replaced that the replacing apparatus be properly wired to insure that new and improper transmission losses may not be introduced from this source. An indication of the kind and magnitude of losses that may occur at the central office has previously been given. Very serious losses may be introduced at substations by the improper wiring of sets. For instance, in a common battery substation set a transmission loss as great as 3.5 miles of standard cable may be introuced by the transposing of the condenser and bell. The transposing of these two pieces of apparatus would not introduce signaling difficulties, thus rendering difficult the detection of the error in connections. Other transmission losses of a serious nature at the substation, which may not interfere with the functioning of the set from the signaling

standpoint, may be introduced by transposing various other connections.

As far as the maintenance of the outside plant is concerned, there are, of course, a number of things to be looked out for: loose ties; broken insulators; excessive slack in the line wires which permits the wires to swing into each other or into guy wires; improper construction at bridling and cabling points which causes these points to be weak spots in the line from an insulation standpoint; hand joints in the line wires; the leaving of emergency cable in the circuit after the real necessity for its use has passed; all of these as well as other things help to impair the efficiency of the service, each thing while small in itself adds just a little to produce a total effect such that probably no one connection can be completed in an entirely satisfactory manner. In one case, for instance, due to excessive slack in the lines, the wires may swing into a guy wire and the circuit will become noisy and then quiet; or in another case where the line is exposed to power induction, generally faulty maintenance and poor insulation may result in the circuit being permanently noisy. Again, for instance, in the case of high resistance joints in the line wires, excessive cross-talk may occur between a phantom and its side circuit when both are simultaneously used. This has previously been pointed out under "Interference."

Duplex Cable.—In bringing toll and long distance circuits into large cities, it is usually necessary to place the circuits in cable construction at the outskirts of the city and to bring them to the city office in cable, the length of cable involved in any particular case varying from a relatively short length up to 10 miles or more. In the past, where the open wire long distance circuits were phantomed, it was often very difficult to bring the phantoms through the cable without introducing excessive noise and cross-talk difficulties. Two or three years ago, however, as a result of a considerable amount of development work, so-called "duplex" cable was begun to be manufactured, and as a result, phantom working in cables is now becoming very common, it being entirely feasible to work a relatively large number of circuits through the same cable over considerable lengths of toll entering cable without interference. The advantages of duplex cable over the old form of non-duplex cable are obviously very great for toll entering purposes, and it is now the standard practice with the telephone companies to place duplex cable in all new installations of this character. It should be noted, however, that while a very considerable amount of work of a research and experimental nature has been directed towards the development of successful duplex cable, it is not possible at present to manufacture commercial duplex cable any considerable lengths of which can be guaranteed free from excessive unbalances without special balancing at the splices. In the present state of the art the requisite high degree of balance cannot be obtained during manufacture and it is necessary that special precautions be observed during installation, so that it may be said that a successful duplex cable *in place* is dependent quite as much upon proper installation as upon the methods used in manufacture. To secure, therefore, duplex cable in which cross-talk is not excessive, the manufacturer should be required to guarantee the finished product in place.

While it was stated above that in all new installations of toll entering cable, cable of the duplex type should be used, there are, of course, a large number of existing toll entering cables of the non-duplex type and through which it may be very desirable to carry phantom circuits. In some cases of this kind the question will doubtless arise as to whether phantoms should be brought in over the existing non-duplex cables, or whether the existing cables should be replaced by duplex cables. It is difficult to lay down any general rules for this use of existing non-duplex cable for phantoms. It does not seem, however, that any large expense should be incurred in replacing an existing cable to provide for phantom until it has been determined by test that the existing cable can not be made to bring in the required number of phantoms without excessive cross-talk. In all such cases cross-talk tests should be made to determine just how severe the cross-talk is, especially between phantoms and their own sides,and between the different phantom combinations. The method usually followed in picking out combinations of pairs in non-duplex cable for phantom working is to arbitrarily select two sets of pairs each, for bringing in two phantoms, and then test these phantom combinations against each other, and each phantom combination against the two pairs making up its own side circuits to determine if they are satisfactory. If either set is not satisfactory, another set is chosen arbitrarily until two satisfactory sets are obtained. A third set is then chosen arbitrarily and tested for its own cross-talk and against the other two phantoms. Progressing in this way, the entire number of phantom combinations which are required in the particular cable in question is obtained. Evidently, the difficulty of doing this increases very greatly with the number of phantoms required. In picking out suitable combinations of pairs for phantom working, also, the question of noise has to be considered. It may be that certain combinations which are satisfactory from a cross-talk standpoint would be too noisy and would have to be discarded on this account. If, in any case, it has been determined by test that a sufficient number of phantom combinations to bring in the open wire phantoms can not be obtained in an existing non-duplex cable, it is then proper to consider the replacing of this cable by duplex cable.

Loading.—One of the potent factors in the development of the Bell telephone system, especially in the extension of the range of long distance telephony, has been the application of the principle of loading;* and the question has been raised on a number of occasions as to why loading can not in general be applied equally as well to the long open wire telephone circuits of various railroad companies to increase the range of transmission over them, or to permit the stringing of lighter circuits and loading them to obtain the desired transmission equivalent.

While very material benefits in the way of increased transmission efficiency and in cheapened line construction are possible by the proper application of loading under certain service conditions, it must be explained that loaded circuits possess characteristics which exclude their use in many parts of the Bell

*Those who are interested in this subject are referred to a paper entitled "Commercial Loading of Telephone Circuits in the Bell System," by Mr. Bancroft Gherardi, presented at the 28th Annual Convention of the American Institute of Electrical Engineers, Chicago, Illinois, July 28, 1911.—(Telephone Engineer, October and November, 1911.)

telephone plant today. It is necessary that the degree of balance on loaded circuits be very much greater than that on non-loaded in order that cross-talk may not be excessive. The effect of leakage or low line insulation on loaded circuits is much more deleterious than on non-loaded circuits. Further, the design of the load coil itself is such that currents beyond certain relatively low values cause magnetization of the core, largely reducing the inductance and introducing irregularities, and the effect of lightning may cause similar difficulties. The introduction of bridges on loaded circuits causes greater transmission losses than on non-loaded circuits and special care is required in connecting loaded circuits to each other and to non-loaded circuits to prevent transmission losses at the junction points. Because of these inherent characteristics loaded circuits are far less flexible than non-loaded circuits and their successful use is limited to conditions that permit of the observing of many necessary precautions.

In general, it would seem that conditions in railroad work are not such that all of the conditions necessary to insure successful operation with loaded circuits can be observed. Where but a limited number of circuits are on the same lead it is frequently necessary that the circuits be used for both through and way business. If these circuits were loaded the introduction of bridges would introduce in many instances losses so serious that the circuits might well be less efficient than if non-loaded. Even if in certain cases a circuit can be set aside for long haul through business exclusively, there are still important reasons from a physical standpoint why loading can not in general be proved in on railroad telephone lines. In loading open wire circuits, it is the practice to space the loading coils as uniformly as practicable at 8-mile intervals on continuous stretches of open wire line. If, however, the lines are broken up by short stretches of cable, the spacing of the loading coils has to be correspondingly shortened up to allow for the higher electrostatic capacity of the cable conductors. While proper allowance can be made when the loading is originally laid out for any stretches of cable which then form part of the circuits, any changes later on, by which relatively short stretches of open wire are replaced by cable construction, will introduce irregularities in the uniformity of the loading, which may be very disastrous from a transmission standpoint. On railroad rights-of-way, more or less reconstruction work of one kind or another is constantly in progress. This often necessitates removing the open wire pole line temporarily in the stretches where the reconstruction work is being done and replacing it with emergency cable. The emergency cable which is used has, of course, a much higher electrostatic capacity than the open wire which it replaces, and, as mentioned above, it would require only a few such conditions on a loaded circuit to render the transmission worse than if no loading had been done. The temporary construction work, moreover, is usually not up to the standard which is required for permanent construction, which means that while the temporary construction is in, the insulation and general maintenance conditions of the circuits will not be up to the high grade which is essential for loaded lines. All things considered, therefore, it is our feeling that except in rare instances the requirements and conditions of railroad telephone and telegraph service would exclude the use of loading.

All that has been attempted in this paper has been to give some facts, a knowledge of which, it is felt, may prove helpful in laying out a railroad telephone system from the telephone transmission viewpoint. One thought which it is particularly desired to have stand out above all others, is that no matter how well the initial design of the telephone system may be, satisfactory transmission conditions will not last unless the system is carefully supervised and maintained. In our telephone system we have found that supervision and maintenance are as essential to good service as the proper initial designing and constructing of the system itself.

"Correct Time, Please"

"What time is it?" is the most expensive question asked in the world today. It costs the great telephone system of this country many thousands of dollars each year to answer it.

In New York alone the telephone company registers one-quarter million subscribers, which makes it possible for that number of people to ask the question each day. But the telephone company is thankful that no such number of people use it for their timepiece. If they did, telephone service would soon be an impossibility, as most of the telephone operators would either go insane or would resign their position, in fear of such a calamity befalling them.

It is estimated that it costs the company about one cent every time it answers the question "What time is it?" If, out of the 2,000,000 calls registered with the New York Telephone Company each day, only 1,000 people asked central for the time, it would then cost $10 a day to oblige them. At the end of the year this figure would count up to $3,655.

And if we consider the whole of this country, instead of one city, we can form some idea of the vast cost of answering the question.

In the language of the telephone company, this query is called a "curiosity question." Everything is being done to dissuade people from asking it; for, besides costing the company thousands of dollars, it ties up the lines of communication and often is the cause of much loss to subscribers.

Ratio of Earnings to Investment

One of the elements not generally recognized by the patrons of telephone companies is the fact that in ratio to the investment the gross earnings are very small, according to an opinion in the Lincoln telephone rate case. In this instance, allowing the increase that the company claims it needs, will produce barely 20 per cent gross revenue per annum on the reproduction value of the plant. As compared to this in the case of our railroads, their gross income will show about 40 per cent of the value, and few business men are prepared to invest capital in a business which does not produce gross revenues running from 100 per cent to 500 per cent of the investment per annum. As a consequence the necessary earnings to cover maintenance, depreciation and reasonable returns on the investment become a very large proportion of the rates needed to keep intact the business of a telephone company, but the very nature of the business makes it impossible to modify this condition and see no prospect of any change of conditions in this respect.

Full Use of Wires

By H. D. Teed*

IT IS not my intention in this paper to go into a technical analysis of all the methods that can be employed in order to get full use of all classes of wires, nor will I attempt to lay down any definite rules that should be followed. There are doubtless, however, some of our members who are at times confronted with problems of taking care of ever-increasing telegraph and telephone traffic, which would seem at the first glance to require an investment in additional wires. Often this is found to be absolutely necessary. Sometimes a careful study and intimate knowledge of the physical condition and relative position on the pole line of present wires will offer a solution. Where present facilities cannot be utilized and additional wires are absolutely required, the ultimate use and possibilities of future additions and combinations that may be effectuated should in all cases be carefully considered.

Perhaps a review of some of the steps that have been taken on the Frisco System along these lines will be of interest. We have considered it of paramount importance to keep our circuits, no matter whether old or new, telegraph or telephone, in the best possible physical condition. It is the anatomy of the wire that we use, and if a part of that anatomy becomes impaired or defective, only by the intelligent use of such indispensable testing instruments as the volt meter, ammeter, and bridge can the defects be entirely eradicated. We have for the past seven years equipped our testing offices with these necessary instruments.

The next most important step is to secure the services of an energetic and resourceful young manager and wire chief and two assistants for each wire testing district, who realize the investment represented by the facilities over which they are to exercise supervision. Unless they are made fully to realize this and enter into the spirit of demonstrating their own ability to handle the large investment entrusted to their charge, it matters little what kind of a wire you have up, or put up. Even though the wire be flawless and erected with the greatest care, extraneous influences may develop defects which, if not promptly located and removed, will greatly reduce the working efficiency of the wire. Incidently, it is of equal importance that appropriate equipment be selected for any class of service. Often too little thought is given these essentials.

In 1908 the Frisco, like several other roads, awoke to the advantages and economies that could be worked out by the substitution of the telephone in train dispatching, and at the same time reasoned that if the telephone was a money-saver in expediting the movement of its trains, the same would apply to the handling of the message traffic, or better still, eliminate it to a great extent and incidentally reduce the great volume of correspondence with which all roads are more or less burdened.

A careful study of our line showed that we possess an advantage over many of our neighbors. Starting at Springfield, where are located our principal operating department heads, our lines radiate in six directions, four of them being the heaviest traffic sections on the road. These we decided to equip with not only a telephone dispatching circuit, but a paralleling message circuit as well, and on these two circuits superimpose a third or so-called phantom for through business between all the terminals, connecting with our private branch exchanges, making a complete and flexible system not only for train dispatching and message service but for intercommunication between our larger terminals, in a way rivaling that of the commercial companies. There had not, however, so far as we could learn, been an installation of this kind made previously. True, our telephone friends had utilized the phantom principle for several years on their toll lines, but their toll lines were not equipped with selectors operated by comparatively high voltage pulsating direct current. Another seemingly serious obstacle to the carrying-out of the plan was the necessity of cutting two of the longest and heaviest dispatching circuits in the middle to meet operating conditions, forcing us to make up one of the side lines of abutting circuits. Owing to lack of space we were obliged to place an additional cross arm over the entire 750 miles, on which we strung four number nine gauge copper wires, transposing each circuit every half mile alternately, and placing a phantom transposition every two miles. The result was perfectly quiet side and phantom circuits before any selectors were applied. The cutting of the dispatching circuits necessitated the installation of some special equipment in the middle of the line and at the terminals by means of which we were enabled to maintain the quiet side lines and phantom.

The middle-of-the-line equipment, that is to say, the points where the abutting dispatching circuits are bridged together, consists, in addition to the regular master selector equipment, of four one-m.f. condensers on the terminal of each wire on the respective dispatching circuits and two No. 39A repeating coils, the centers of the coils being connected together. The message circuit terminals are similarly connected through condensers, permitting the passage of voice currents. The impulse currents actuating the selectors are passed around the condensers by utilizing a 3,500-ohm relay, the local points opening and closing the intermediate main battery.

The terminal equipment consists of eight one-microfarad condensers, two in multiple, on each wire, and two No. 39A repeating coils tapped in the center and carried to the P. B. X. board jack. A No. 47J bell is bridged across the tap, providing a means of signaling between the exchanges on the phantom, the standard signaling current at the P. B. X. boards being sufficient to ring through. The dispatching and message circuits are also cut into the P. B. X. boards, but no connections are permitted on the former. The signaling on all the message circuits is done by the monitor operators, who are all located in the main P. B. X. operating room at Springfield, and they are on the lines all the time during the day. At night the signals, actuated by generators at all stations, are switched across the line and attract the monitor operator's attention. The monitor operator's board is provided with trunks to the various auxiliary private branch exchanges. The through calls on the phantom are handled by the P. B. X. operator; likewise, calls from the phantom to sub-stations off her board. A phantom call for a station on any message circuit is trunked to-

*Paper read before the Association of Railway Telegraph Superintendents.

the monitor operator, who signals the station desired. The system is, therefore, flexible.

The phantom represents, in effect, an investment of approximately $143,000, or the cost on the poles of two No. 6 B. & S. gauge copper wires fifteen hundred miles long, yet this circuit cost the Frisco Railroad less than $800 and gives three circuits out of four wires.

We have not attempted to utilize these wires for telegraph service, as the release of the telegraph dispatching circuit and the local Morse circuit on all the territory referred to gave us two additional iron wires which are used for through business; all local business is now handled telephonically.

Very satisfactory and economical telephone service is obtained from the use of composite or telegraphone instruments operated on Morse circuits when confined to short distances. The Frisco has in quite a number of instances avoided opening telegraph offices by connecting a telegraph office with a non-telegraph office by means of these instruments, permitting the non-telegraph office to obtain all necessary information regarding trains, orders for cars, etc. An installation of this kind costs so little, however, that it is difficult to overcome the inclination to attempt to operate them a greater distance than they can reasonably be expected to work.

On a portion of the line ninety miles long where we have a metallic manual block made up of two No. 8 iron wires transposed every half mile, a condition arose almost over night necessitating an additional local message Morse circuit.

Each station had two telephones, one used for blocking in each direction. By connecting the centers of the ringing coils in series with the telegraph switchboard at each station, and the centers of the terminal coils with battery a simplex circuit was obtained and placed in service on the second day. No additional apparatus excepting the Morse instruments was used.

I have purposely omitted any reference to the duplex and quadruplex, as anything I might say would be a repetition.

There will be within the next few years, no doubt apparatus developed and combinations worked out that will result in still greater use of wires.

Safety for Telephone Employees

L. H. Kinnard, second vice-president and general manager of the Bell Telephone Company of Pennsylvania, comments at some length on the wonderful strides his company has made toward the safeguarding of its men and women.

"The occupation of building and maintaining a telephone plant," says Mr. Kinnard, "is not generally considered hazardous when compared with railroad work or the operation of machines in factories. Still it must be acknowledged that a certain number of accidents will happen in any body of 4,000 working men, approximately the number of men employed by the Bell Telephone Company of Pennsylvania and associated companies.

"Our company recognizes that there are accidents, and that there will always be accidents, but it desires to reduce their number to a minimum. Adopting the slogan, 'Safety first,' this company appointed some time ago a safety committee, with a membership consisting of W. T. La Roche, general superintendent of plant; Nathan Hayward, the engineer; J. S. Francis, the engineer of appraisals, and E. J. Speh, the superintendent of supplies, to study the accident question, to arouse the interest of the workmen in acquiring the safety habit and to adopt means of correcting defects in material or methods.

"We appreciate that if an accident occurs there must be something wrong with the men, the method, the material or the tools, and so a report of each accident, no matter how trivial, is made to the safety committee.

"If the accident is at all serious, a committee of workmen, composed of men of the same grade as the injured employe, investigates the accident and makes a detailed report of its findings, showing the causes, the responsibility and the steps which, in its judgment, should be taken to avoid a repetition of the same kind of accident.

"The safety committee considers the accident report in detail, together with the workmen's committee reports, and if the necessary corrective action has not already been taken, forwards its suggestions to the plant superintendent, who, in turn, passes them to the foreman who is responsible for remedying the conditions.

"Suggestions relating to changes in standard methods, material and tools are sent to the engineer, if such action is deemed advisable. The findings of the safety committee are handled in this way in order to assist the supervising employes in acquiring the safety habit, for it is necessary for the supervisors to be in sympathy with the safety campaign in order to maintain a proper degree of interest on the part of the workmen.

"Descriptions of accidents of general interest to all workmen, and the means of preventing similar accidents, are published in the Bell Telephone Company's paper, as well as safety hints which the safety committee issues either upon its own initiative or from suggestions which have been received from the men. The main idea is to prevent accidents by arousing interest on the part of the workmen in protecting themselves.

"Realizing that there are accidents, and desiring to mitigate the sufferings of the victims of such accidents as much as possible, the Bell Telephone Company decided, as part of the campaign, to reduce the number of accidents, provided rules for rendering first aid to injured persons and to furnish the first-aid kit to each gang of workmen and each office where men are accustomed to congregate.

"The matter was discussed with Major Charles Lynch, medical corps of the United States army, in charge of the first aid department of the American Red Cross. Major Lynch has been deeply interested in welfare work for many years, and volunteered to prepare suitable rules and a suitable first-aid kit for the Bell Telephone Company. The rules adopted are the result of Major Lynch's work. They cover a wide range of topics, from the dressing of cuts to the restoration of respiration.

"The first-aid box contains suitable material for the immediate dressing of wounds, bruises, sprains, fractures, dislocations, sun strokes, heat exhaustion, burns, scalds and frost bites. They are intended to make an injured person comfortable until a physician can arrive at the scene of the accident, and to prevent, so far as possible, serious consequences which might result from an accident.

"In order that the Bell Telephone Company's workmen might receive adequate instructions in rendering first aid, the assistance of Major Lynch was again solicited and, at his instigation, Dr. Matthew J. Shields, field representative of the American Red Cross, has been assigned to the company's work. Doctor Shields is one of the pioneers of the first-aid movement in the United States and has conducted classes in first-aid work throughout the Bell Telephone Company's territory, and

all of the workmen have had an opportunity to attend at least one of his lectures.

"In his class work Doctor Shields gives a general talk on the subject of accident prevention, calling attention to the fact that their part in the corrective work represents about 70 per cent, while the company's part, together with the unpreventable accidents, represents the other 30 per cent of the total.

"Doctor Shields then selects a subject from among the men attending the lecture, and, while he describes the proper way of stopping bleeding and of applying bandages to the different parts of the body, he illustrates his description with actual applications of bandages to his living subjects. He also shows the proper method of restoring breathing to persons who have been rendered unconscious in any manner by actual manipulation of the subject.

"The class work is handled in a most impressive manner, and always appeals to the men. Among other things, Doctor Shields shows the proper way to carry injured persons on stretchers and chairs, and a feature of the demonstration is a stretcher made from two coats and two pikepoles or digging bars.

"This stretcher is improvised as follows: One man holds the two pikepoles, one in each hand, while a second man removes the coat from the first man by slipping it over his head, so that the coat and coat sleeves are pulled over the poles. The hands and the poles are then grasped by the second operator and his coat is removed in a similar manner.

"This unique demonstration appeals especially to Bell telephone men because it can be performed with the ordinary tools of trade and things which the men have always with them. This series of lectures impressed upon the men the necessity of exercising extreme care in their work and of realizing the responsibility of each individual in matters of safety.

"The men who attended these lectures ranged all the way from the supervisors, who have 200 or more men under them, to the janitors, and among them were the wire chiefs in charge of the central offices where the 'heart' of the telephone service beats, the 'trouble shooters,' highly trained men who are responsible for the repairing of any trouble or breaks in the plant or equipment, the cable splicers who work underground in the conduits and overhead putting together and splicing the cables, the collectors who ride motorcycles, chauffeurs who drive automobiles and trucks and laborers."

To further illustrate the attention paid by the Bell Telephone Company toward preventing accidents among its employes, Mr. Kinnard stated that printed "safety-first" rules have been issued for the guidance of men doing hazardous work, and, in conclusion, added: "The men's interest in this work lies in preserving the 'whole body' and the company's in preserving the 'whole organization' of skilled workers.

Extent of Railway Telephones

G. K. Heyer, a railway telephone engineer, at the Western Electric telephone specialties conference, made some interesting comment with reference to the more general usage now made of the telephone. He said there are approximately 285,000 miles of railroads in the United States and Canada. Train movements from 1851 to 1908 were governed by telegraph. The first telephone dispatching was tried in October, 1907. Today there are some 70,000 miles of railroad operated by telephone. Many large roads are now nearly fully equipped. Among them are the Lackawanna, New York Central Lines, Lehigh Valley, and Atchison. Forty per cent more work can be done by dispatchers with the telephone. Some roads report a saving on an average of an hour and a half in running time on all freight trains. This amounts to about $14,000 a year for each 150-mile section. Trains are being equipped with portable telephones so that the train crews can talk with the dispatcher. Iron box telephones at the sidings speed up the freights and save overtime. On many of the lines all but the through traffic is handled by the telephone.

Conference of Sales Specialists

The second general conference of Western Electric telephone sales specialists was held in the La Salle Hotel, Chicago, during the week of August 4. Thirty-one specialists representing all of the distributing houses, attended, besides several guests, members of the Chicago sales department, and general department representatives. The specific purpose of the conference was to discuss sales campaigns and sales methods rather than selling points, the latter having been discussed thoroughly at the first conference in 1911.

E. A. Hawkins, general telephone sales manager, presided at the daily sessions, which were numerous and strenuous. The meetings began at 8:30 a. m. and continued until one o'clock; they recommenced at 2:00 p. m. and lasted until dinner time. Three evening sessions were held in addition, and two afternoons were spent in visiting the Hawthorne works of the company.

More than eighty papers were read and discussed. These will be published in pamphlet form and issued as a telephone salesmen's manual. A novel scheme was employed to prevent the reading of any one paper from encroaching on the time allotted to the next one. Two switchboard lamps were fastened to the chairman's table, from which the papers were read, and connected to a switch on the table of the secretary. Three minutes before the reader's time limit was up a green lamp was lighted; when his time was completely up, a red lamp glowed. This proved a very effective way of conveying the message without either "rattling" the speaker or distracting the attention of the audience.

Nebraska Commission News

Complaint has been filed with the state railway commission against the Nebraska Telephone Company by the Hooper Telephone Company, alleging the former has refused to make physical connections with the Hooper concern. The refusal cuts out 1,000 parties, who formerly had connection with Fremont.

Despite the fact that the lines of the Wilkinson Telephone Company pass within 200 feet of his home and that he has tendered the company's officials the price of connecting his residence with the system, John L. McBride of Lincoln, says that he has been unable since June, 1911, to obtain the service. He has laid the matter in the hands of the railway commission for settlement. A reply from the company officials was received in which the assertion was made that as soon as a pending legal action in the matter is settled the company will take up this complaint. The commission, however, has replied by saying that it expects information at once and that the prevalency of litigation has nothing to do with this.

Of Interest to the Trade

Locating Breaks with an A. C. Mil-Ammeter

By R. T. DAVENPORT.

A LARGE part of the cost of clearing trouble on long telegraph and telephone lines is due to the fact that wire chiefs and test board men are not provided with means for accurately locating breaks or "opens." This is especially true of lines in the West where test offices are frequently from 20 to 50 miles apart, and transportation facilities for linemen are both few and expensive so that a repair is quite a serious thing.

The methods usually employed for locating opens in cables cannot be successfully applied to open-wire lines, and, as a general rule, no attempt is made to determine the position of a break beyond locating it between two test offices, and then going out after it.

The development of the alternating current mil-ammeter has now made possible a method by which this class of opens can be located with great accuracy. This method is based on the fact that when an open wire is

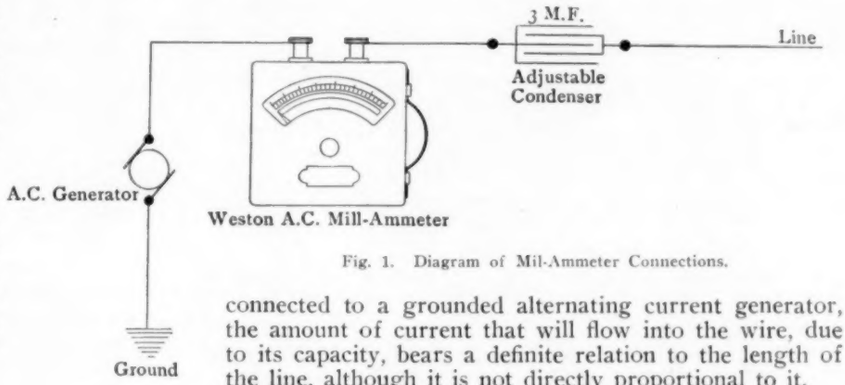


Fig. 1. Diagram of Mil-Ammeter Connections.

connected to a grounded alternating current generator, the amount of current that will flow into the wire, due to its capacity, bears a definite relation to the length of the line, although it is not directly proportional to it.

This principle is applied to the location of opens by the use of the arrangement shown in Fig. 1. The function of the adjustable condenser is to eliminate the effect of induced currents set up by parallel telegraph circuits, and to afford a means of varying the strength of the alternating current, as will be explained later.

To determine the relation of the amount of current to the length of the line a good wire is opened at the most distant test office and the condenser or voltage adjusted to give the maximum readable deflection. Then, with the same voltage, frequency and condenser adjustment, readings are taken to opens at all available offices and test poles. From these readings a curve is plotted as shown in Fig. 2.

A separate curve must be made for each pole line because both the amount and location of the capacity are different for different lines. If a line contains any considerable length of cable a reading should be taken to opens at each end of it, as the presence of cable or twisted pair greatly changes the shape of the curve. By keeping a record of all measurements and the actual location of the breaks found by linemen many new points can be located between offices and the curve changed to conform to them, thus making it more nearly correct.

Repeated experiment has shown that in a dry country these values remain practically constant, but inasmuch as the capacity and insulation resistance of all lines are subject to variations, it is advisable before making a measurement to take a reading to an open, either on the faulty wire or on a good wire of the same size, at the test office nearest the break. If any discrepancy is noted the voltage or condenser is varied until the reading shown by the curve for that office is obtained. A reading is then taken on the faulty wire to the break and the location of the open read directly from the chart. If the end of the broken wire towards the testing office is grounded the distant portion of the wire can be looped back from the first office beyond the break, and the necessary calculation made to locate the open. When both ends of the broken wire show heavy leakage approximate locations may still be made provided the wires are not dead grounded. A D. C. mil-ammeter and a source of direct current with the negative pole to the line should be used to determine

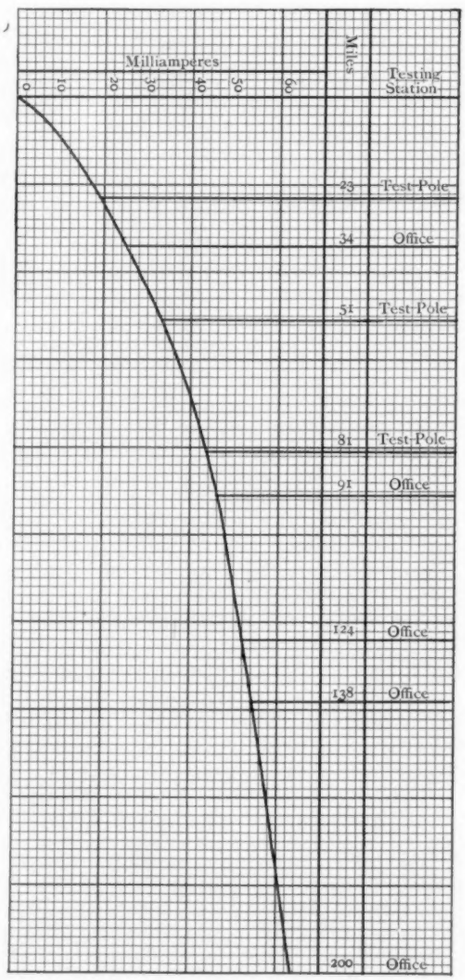


Fig. 2. Curve Slotted from Mil-Ammeter Readings.

the amount of escape at the break. The ordinary voltmeter is not suitable for this purpose.

Within a radius of 150 miles breaks can be located by this method with an average maximum error of not over two miles. Beyond this distance the accuracy decreases, but it is of great value up to 200 miles. For greater distances the curve becomes too flat to be of use.

This method has been in use for nearly a year on a number of pole lines aggregating about seven hundred miles in length, and has given most satisfactory results. As one instance of the great saving in maintenance effected by its use, it may be stated that on one of those lines the first test office is located 138 miles from the testing station. It was formerly the practice when a break occurred in this section to start a lineman from each end. It generally took two days to clear the trouble and much expense was incurred by the linemen for transportation and meals. Since the adoption of this method breaks are closed with little loss of time and with a minimum of expense.

The mil-ammeter used in connection with these tests is the Weston A. C. portable type, having a scale of 0 to 75. It is dead beat, and when used with the condenser is not affected by induction from parallel circuits. On lines that do not carry telegraph the condenser could probably be dispensed with if some means is provided for carrying the voltage of the generator without changing the frequency.

Besides being used for breaks on outside lines many other uses of the A. C. mil-ammeter will suggest themselves to the experienced wire chief. For instance, knowing the normal deflection to the end of the cable, it is an easy matter quickly to determine if a circuit is open in the cable; in the protectors at the distant end of the cable, or beyond them. It also affords a quick means of locating open fuses in a distant test office.

This instrument when used intelligently will quickly pay for itself in saving of time and mantenance expense, and is a most useful addition to a wire chief's testing equipment.

A Voltmeter of New Design

(By H. A. Morss.)

In the high voltage testing of wires and cables, made usually on open circuit, there appears to be considerable misconception of the fact that it is the peak of the wave which tends to break down insulation, rather than the "average" reading of the ordinary voltmeter. Engineers take it for granted that there are no difficulties because no current is required. Such is not the case, however, and it is my purpose to describe some of the difficulties, and a new type of voltmeter which has been developed by the Simplex Wire & Cable Company for use in making such tests. For cable testing, alternating current is used in connection with a transformer or transformers, and some means must be devised for regulating the applied voltage between very low and very high limits. A certain number of steps may be had by using a transformer containing several windings and connecting these in multiple, series multiple, or series, but in order to get all the regulation required, it is usually also necessary to vary the voltage of the generator supplying current to the transformer. A common way to accomplish this is to vary the resistance in the field circuit of the generator.

Owing to the electrostatic capacity of cables of commercial lengths, considerable flow of current is required to maintain the necessary test voltage. The effect of this capacity is to change conditions in the generator, and thereby cause distortion of the wave form. This condition makes the ordinary voltmeter practically useless.

Of course, the ideal wave form for high voltage testing is the sine wave, and if this can be maintained the ordinary voltmeter is sufficient. When, however, the wave is distorted and the voltmeter still reads only the square root of the mean square, it gives very little indication of what is actually happening as regards a breakdown test. The peak of the wave is what counts so far as the breaking down of insulation is concerned. It follows, therefore, that the strain may actually be much larger than shown by the voltmeter if the wave is distorted into a high peak, or the strain may be less than indicated, if the wave has become flattened.

Realizing from experience that under certain circumstances something queer was taking place, we applied an oscillograph to our testing circuit and immediately found that the real strain, which is due to the highest point of the wave, was not really indicated at all by the voltmeter.

The standardization rules of the A. I. E. E. require in voltage testing that an alternating voltage be used with an effective value equal to the square root of the mean square referred to a sine wave.

In the case of a sine wave, the effective voltage is about 70 per cent of the maximum voltage. Therefore, in cable testing a maximum voltage about 144/10 times the required voltage should be used, and the question arises how to determine this maximum under all conditions of testing.

An oscillograph shows the maximum, but an oscillograph is a delicate and cumbersome instrument for factory use where a large number of tests are made every day. It occurred to us, however, that an instrument might be made on the principle of the oscillograph, where, if the vibration could be confined to a straight line, this straight line would show the limits of oscillation, and its end indicate the peak of the wave. Further, it would be extremely simple to calibrate the instrument at any time by applying direct current of known voltage.

This proposition was laid before Professor F. A. Laws of the Massachusetts Institute of Technology, and Chester L. Dawes of Harvard University. They built an instrument which although somewhat crude achieved the desired result and demonstrated the feasibility of the scheme by a test of three months' use under factory conditions. Now the Leeds & Northrup Company is at work perfecting a commercial and usable instrument, which it is expected can be put on the market at a reasonable price in the near future.

This voltmeter was developed by the Simplex Wire & Cable Company wholly because of its need in the high voltage testing of wires and cables, and because no instrument fulfilling that need could be found in the market. It appears, however, that such an instrument should have varied uses, for many engineers must be interested not only in the voltage as shown by the ordinary meter, but also in the actual maximum voltage present in generators, transformers, meters or transmission lines.

A "Newsy" House Organ

The September issue of *Automatic Telephone*, the monthly house organ of the Automatic Electric Company, Chicago, just from the press, maintains the high standard set by the three preceding numbers. Printed in the form of a newspaper, this publication is in many respects unique in its field. It presents each month the news of automatic progress throughout the world, besides giving

space to many items of general interest to telephone men, manual as well as automatic.

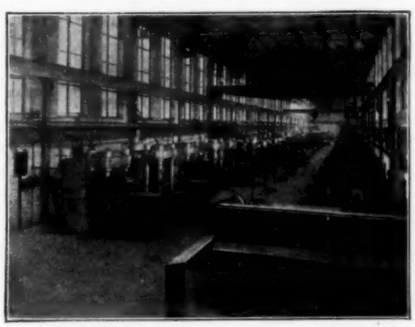
In addition to these news items each issue of *Automatic Telephone* has contained a number of technical papers discussing various phases of telephone operation. Development studies and fundamental plans are dealt with in one series of articles while another series presents various phases of scientific management as applied to telephone exchanges. The electrical and mechanical principles underlying automatic switching are explained in another series of articles and a short history of the various steps by which automatic apparatus has been developed, is also being published.

For a number of years automatic telephony has been receiving very careful attention from practically every one engaged in any way in telephone work and each year the interest in this subject grows more widespread. An inspection of the four numbers of *Automatic Telephone* already issued, convinces us that this publication will be of real assistance to all who are studying this subject.

How Telephone Cable Is Made

Merely stating that modern telephone cable consists of a group of copper wires, insulated by a wrapping of manila paper, twisted into pairs, and enclosed in a lead sheath, does not convey any idea of the complexity of the processes by which it is manufactured. These processes, as carried on in the Hawthorne factory of the Western Electric Company are described in a recent issue of the *Western Electric News*.

The materials of which cable is composed are copper wire, manila paper, tin and lead. These are furnished by the carload, the wire rolled in coils, the paper wound on spools, and the tin and lead in bars, known as "pigs." The wire is known as "soft drawn.' It has been thoroughly annealed, *i. e.*, softened and made flexible and drawn to the proper diameter, and differs from the so-called "hard drawn" wire used in outside line construction in its toughness and flexibility. The paper, which varies



Sheathing the Core.

in thickness from 2½-1,000ths to 14-1,000ths of an inch, is especially made from the best manila rope fibre and is consequently very tough and durable. The metals are chemically pure tin and lead.

THE INSULATING PROCESS.

The first process that is actually carried on in the cable, rubber and insulating shops at Hawthorne is that of insulating the copper wire with its paper wrappings. The insulating machine consists of a number of revolving discs, an equal number of "capstans," or large pulleys, and the "take-up" reels. The bare wire is coiled loosely around large iron spindles. From there it passes over the pulleys at the top of the machine through the center of the revolving discs. On the face of each disc a pad of the insulating paper is placed, and as the wire is pulled through the hole in the center by the capstan beneath, the disc revolves, winding the paper around the wire in the form of an endless spiral. The insulated wire then passes over the capstan and is wound upon the take-up reel below.

Each disc is driven by an individual motor, and applies the paper to the wire at the rate of 2,400 to 3,000 "wraps" or turns a minute. Various colored papers are used, in order to make it easy to identify different sizes

The Insulating Machines.

of wire or different pairs of wires in the finished cable.

PAIRING THE WIRES.

The insulated lengths of wire are now ready to be twisted into pairs. Two of the take-up reels containing insulated wire of the same color are placed in spindles in the machine. A capstan at the top of the machine then draws the wires through a "yoke"—a revolving plate pierced by two holes through which the wires pass—twisting them together, and leads the twisted pair to another take-up reel. The machine is so adjusted that the length of the twist, that is, the number of twists to the foot, may be altered at will. Different lengths of twist are used for different "gauges" or sizes of wire.

FORMING THE CABLE.

The twisted pairs of wires now go to the stranding machine to be formed into a cable. This machine consists of a number of revolving drums, which look like enormous skeleton spools. On the outer circumference of these drums are arranged the reels containing the various pairs. A large capstan draws the center pair or pairs of wires straight through the center of the machine; at the same time, the drums revolve, and the other pairs are unwound from the reels and are twisted in alternate directions around the center. The finished "core," as the unsheathed cable is called, emerges from the machine, and is wound upon the capstan. The last layer of pairs is covered with a double wrapping of paper, to protect the core from the lead sheathing.

In order to cut the cable to the lengths desired by the customer, one of the center pairs is carefully measured and the location of the end of this pair marked on the outside of the core. As it is often important to the customer that the lengths be absolutely correct, a check measurement is usually obtained, either by means of a recording device on the front of the standing machine, or by weighing the completed cable.

THE DRYING PROCESS.

After leaving the stranding machine the entire length of cable core is carefully tested, to make sure that none

of the wires are broken, and also that the paper insulation is perfect. The next process, that of drying, is very important, for the quality and efficiency of the cable depend to a large extent upon the care with which it is carried out.

The core is placed in gas ovens heated to 215 or 230 degrees Fahrenheit, and is kept there for a period ranging from 15 to 48 hours, depending on the size and length of the core, the amount of insulation, and the character of service for which the finished cable is intended.

SHEATHING THE CORE.

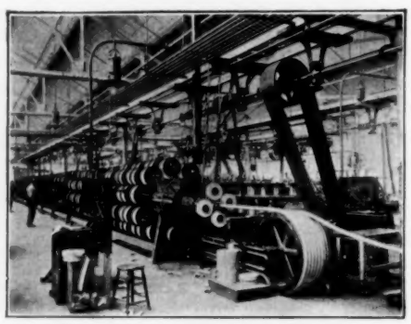
When the core has been thoroughly dried, it is put through the last manufacturing process, that of applying the lead sheath. The lead press, or sheathing machine, on which this operation is performed, is practically a machine for making lead pipe. It consists of a huge pot, or container for holding the metal, a core and die box, and a hydraulic press.

The container is filled with molten lead, to which an alloy of 3 per cent tin has been added. The bottom of the container opens into the top of the core and die box. The "core" is a pipe through which the cable passes; the "die" is a mold surrounding the core. The cable to be covered passes into the back of the machine, through the core and the die. By this time the lead in the container is no longer liquid, but has cooled sufficiently to be in a plastic state. It would not do to apply the molten lead to the cable core, because the hot metal would burn the paper insulation off the wires.

The hydraulic press, working at an enormous pressure, forces the plastic lead through the die, or mold, and around the cable core, thus surrounding the paper covered wires with a continuous lead sheath of any length.

FINAL TESTING.

As soon as the finished cable is cool enough to handle, it is given a final and very thorough electrical test. As it is essential that every cable contain at least as many perfect pairs of wires as are called for in the order, a few extra pairs are usually included in order to make up



Forming the Cable.

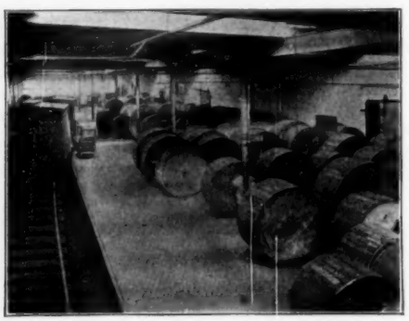
for any defective pairs that may be detected in the course of the final inspection.

SEALING THE ENDS.

When the cable has tested satisfactorily, the ends of the core are impregnated in paraffin and the sheath is sealed up so as to prevent possible entrance of moisture, after which the finished product is ready for shipment. Testing of the cable is one of the most important phases of its manufacture.

The processes just described are those for making telephone cable in general. There are, however, different types of cable, and their manufacturing processes vary. The so-called "silk and cotton cable," which is used largely on the telephone subscriber's premises, particularly for inter-phone installations, differs from the standard in that the wrapping of the bare wire consists of silk and cotton in place of paper. The so-called "wool cable," which is used in telephone exchanges between the manholes underground and telephone exchanges, has a wrapping of wool in place of the paper, the wool offering a greater resistance to moisture. Submarine cables carry both heavier insulation and heavier sheath.

The modern lead sheathing process places no limit



The Shipping Department.

on the length of single cable. A cable recently made for the Western Union Telegraph Company consisted of two lengths of 37-pair cable, each of which was 5,500 feet—over a mile—long. The thickest cable made contains 600 pairs of No. 22 gauge wire, with an outside diameter of 2⅝ inches.

The cable factory is a one-story building, which at first glance seems insignificant when compared with the other and more massive buildings of the Hawthorne plant; but enormous weights of raw material are handled —2,000 tons of paper, 10,000 tons of copper, and 30,000 tons of lead being made into cable in a single year. The single-story building is the ideal cable factory, for with every process carried out on the same floor unnecessary lifting of the heavy material is avoided.

There is not a single lost motion as the manufacture progresses. At the east end of the building, cars containing raw material are unloaded and the sequence of the locations of the departments—insulating, twisting, stranding, baking and sheathing—is arranged so as to correspond with the order in which the cable evolves. At the other end of the plant the finished product is rolled into waiting cars. This cable factory is an excellent example of the successful application of the principles of scientific management.

A. R. Benson Adds Equipment

The Alexander R. Benson Company has added to its equipment quite a number of additional pieces of apparatus in order that its well-known soldering paste and soldering salts will be able to maintain their quality on a newer and higher standard than ever before. A Fuller & Johnston engine has been installed to take care of the increased business which the company received during the past year, and an efficient cold-storage plant has been built. The purpose of the cold storage plant is to keep the salts cool and dry after they come from the evaporating pans, which assists in keeping the product in good condition. A grinding mill larger than any heretofore

used has been put in to grind the salts finer, which naturally tends toward a higher quality of product, and a new paste mixing mill has been added. Lloyd R. Benson is taking a very intense interest in this business and with the added equipment the Benson Company may be expected not only to maintain the increase in business, but add to it during the coming fall and winter.

The Hand Set Inter-Phone

The hand set Inter-phone which, with the wall and desk stand types, completes the line of intercommunicating telephones manufactured by the Western Electric Company, is a particularly convenient form of telephone instrument. Transmitter, receiver and ringing button are all mounted on one handle, so that while the Inter-phone is held and operated entirely by one hand, the other hand is left free.

The button is mounted on the inside of the hand set handle in such a position that when the Inter-phone is taken up for use the index finger, in the natural position of the hand, can be placed directly on it for calling the party wanted. Two hands are never necessary for the operation of this Inter-phone.

The hand sets are also so constructed that when not in use they can be placed in any position without causing waste of battery current as the current is shut off automatically when the pressure of the hand is released. The value of this will be apparent when the users forget to hang up the hand sets after they are through using them. The compact form of the hand set Inter-phone makes an ideal form of intercommunicating telephone for the home. It adapts itself equally well for easy chair or bedside use. The busy business man will find it equally convenient. It can be hung at the side of his desk just within reach but out of the way of papers and ink-wells.

A flush type wall box with face plate, the same as that used in electric light wiring for a push button switch, is used to hold an apparatus unit which contains the line terminals and the signaling buzzer. This feature is of special importance as it enables the contractor or dealer to make use of standard stock parts and will prove of great value as a business getter.

When the contractor receives an order to install a buzzer or annunciator system either in an old or new building and cannot just at that time induce his customer to put in an Inter-phone system, he can install, instead of the ordinary push buttons, the standard wall boxes and Inter-phone face plates, which have a push button that can be used for the regular annunciator call. These will be furnished at a price sufficiently low to add no expense to the contractor's work. The contractor can then, at a little later date, approach his customer and call his attention to the manner in which he has paved the way for an intercommunicating telephone system. The mere fact that wiring and wall boxes are already in place and the hand set Inter-phones need only be plugged into the face plates in the same way that vacuum cleaners, fans, electric irons or portable lamps are connected in the modern home or office, will prove a clinching sales argument. Half the sale is made when the annunciator system is installed.

With the flush type sets nothing projects beyond the wall but the hand set which hangs from a hook on the face plate. For old buildings where it is not convenient to mount the flush type, non-flush boxes are available. These are small inconspicuous metal boxes finished in a dull black and contain terminals and buzzer. They will mount anywhere, on desk or wall.

There are a number of different systems: one for every condition of service and one for every condition of purse as in the case of the wall and desk stand types. Hand sets, wall and desk stand Inter-phones for any one system are interchangeable. The system, known as No. 16, which requires only two wires, is especially adapted to residences or hotels where annunciator systems are already in operation. In this system the old wiring can be used without making any changes.

Commercial Relations of the United States

A concise volume, which contains statistics showing the foreign trade of each country of the world during 1911 compared with the previous year, has just been issued by the Bureau of Foreign and Domestic Commerce at Washington. This valuable publication shows the principal articles and their value entering into the trade of each country and the itemization of the imports from and exports to the United States. The statistics were prepared by American consular officers, and supplemented by other official data. In addition to trade statistics, the grain crops and mineral output of the principal countries are given, thus presenting in compact form the principal features upon which the commerce and industries of the foreign countries depend. The volume should prove highly valuable for reference purposes, having been revised and brought up to date so far as statistics were available. Copies of the book may be obtained from the superintendent of documents, Washington, D. C., for 35 cents each.

More Progress in Automatic Field

Two orders, aggregating 10,000 lines of automatic telephone equipment, have recently been placed with the Automatic Electric Company of Chicago through the Automatic Telephone Manufacturing Company, Ltd., of Liverpool and London.

One of these orders is for a 5,000-line exchange to be installed in Portsmouth, England, site of the great naval station, and one of the country's most important seaports. The other order is for a similar exchange in Rosario, Argentine Republic and is the third automatic equipment ordered for that country, the installation of exchanges at La Plata and Cordoba being already under way.

Among other orders recently placed for automatic telephone equipment are 2,000 additional lines for the Los Angeles exchange; 1,500 lines to extend the Edmonton, Canada system; 1,300 lines for the Auckland and Wellington, New Zealand plants, and an initial installation of 800 lines for the Dakota Central Telephone Company at Watertown, S. D.

A Texas Consolidation

J. B. Earle, president, and Ben C. Hyde, vice-president of the Brazos Valley Telegraph and Telephone Company, have just taken over the property of the Home Telephone Company at Orange, Texas, a concern of $30,000 capital.

This purchase has just been announced, President Earle and Secretary E. C. Plomeyer having returned from Orange, where the property was taken over. The Orange exchange is to be included in the independent system of the state, and it will be operated from the executive offices in this city.

Waco is the home of the general offices of the big independent telephone system. It represents a capital and

bond issues of over five and one-half million dollars. It controls all of the independent exchanges in Texas south of Dallas except two, and the local exchanges are connected up by toll lines. The system has been gradually enlarged by purchases from time to time, which have been made by Mr. Earle and Mr. Hyde and from the formerly restricted operations of the independent property in central Texas there has grown the great system that is now controlled, with Waco as the central point, having the general offices.

Telephone Men Enter Protests

The Pennsylvania Public Service Commission heard arguments for several hours from representatives of independent telephone companies against the proposed schedule of rates for all companies operating in the state, and will not act until other companies, including the Bell system, can be heard.

Summed up, the objections were that the imposition of a maximum rate would ruin many small companies, and that abolition of the flat rate would take away one of the advantages in competition. It was emphasized that there is no monopoly of telephone business in the state, but a very real and active competition.

Henry M. Tracy, of Conshohocken, receiver of the Cumberland Valley Telephone Company, was the principal speaker, making an extended argument which was endorsed by others and heard with close attention by the commission.

Treatise on Cable Electrolysis

The Automatic Electric Company of Chicago, manufacturer of automatic telephones, has just issued an engineering bulletin on "The Prevention of Electrolytic Corrosion of Lead Covered Telephone Cables." This pamphlet was prepared by Bernard C. Groh of the company's engineering staff and is illustrated with diagrams and drawings. It deals with a subject which is becoming increasingly important to all who have charge of telephone construction work. The appearance of this bulletin marks one more step in the service campaign which the Automatic Electric Company has inaugurated and which the company believes will prove of value not only to those operating its automatic apparatus, but to the telephone world in general.

Maryland Commission News

The Chesapeake and Potomac Telephone Company of Baltimore applied to the Public Service Commission for permission to purchase the Severna Park Telephone and Telegraph Company of Anne Arundel county. The Commission announced that a date would be set for hearing the application. The Severna Park Company operates a telephone exchange at that place. It is owned entirely by W. Craig Lord and Oscar L. Hatton. The price stipulated in the application is $900.

Appeal for Competition in Wisconsin

An appeal from the decision of the Wisconsin Railroad Commission refusing a certificate of convenience and necessity to the Citizens' Telephone Company, Eau Claire, Wis., has been taken to the circuit court of Dane county. Notice of appeal was filed in the office of the commission today by Sturdvant & Farr, attorneys, of Eau Claire.

Some time ago the Citizens' Telephone Company filed a petition with the commission asking that it be granted a certificate of convenience and necessity to operate its lines and exchange in the city of Eau Claire. After a hearing upon the petition and upon the advice of Attorney General Owen it was denied and the present case is brought to set aside that denial and compel the issuance of the certificate.

The case will be an interesting one as it affects one of the vital points maintained by the commission, that is to prevent unnecessary competition.

Compulsory Connection in Indiana

Attorney General Martin, in answer to a question from the Indiana Railway Commission, has given an opinion holding that the law passed by the last legislature requiring the connection of telephone lines does not apply to two competing companies in the same town but applies only to long distance or toll business. This is his interpretation of H. R. No. 21, a bill introduced by Shipley of Dodge county.

The question asked by the Railway Commission is as follows: "Does H. R. 21 require the physical connection of local and competing companies for the exchange of local calls, or are its provisions applicable only to long distance or toll calls?"

After quoting a section of the law the attorney general says:

"In my judgment, this law was designed to require the transmission of long distance messages from the lines of one company on to the lines of another company, and was not intended to provide for the interchange of local calls, or messages over the lines of two or more competing companies."

Des Moines Mayor Boosts Automatic

Installation of automatic telephone devices to replace the equipment in use is the solution of good telephone service in the opinion of Mayor Hanna of Des Moines, Ia., discussing the resolution adopted by the suffragists in convention at Union park, calling upon the city council to make an investigation of the alleged poor service.

The mayor says he does not believe the operating company will ever be able to give satisfactory service with its present equipment. He thinks the whole exchange should be remodeled and the automatic devices installed. The possibility of errors, losing connections, and other annoyances would be eliminated by doing away with the human element in the operation of the exchange, the mayor thinks. He does not blame the operators. They have about all they can do, and sometimes more than should be expected of them.

The only way to get improved telephone service is to organize a demand for the automatic system, the mayor says. The city council has no power over the company. It may investigate the service every week, and may find where the trouble is, but it is powerless to enforce its finding. The telephone company is under state control.

"It will do no good for us to investigate the telephone situation again," the mayor said. "The service is below the standard, but the city council has no power to order the company to improve it. I have no hope that we will ever have satisfactory service as long as the manual system is in use here. The automatic devices

would end the difficulties, I believe. If service is to be improved it must be through concerted action of the patrons of the system."

Rate Contrast Sustained

Judge W. E. Porter handed down an important decision at Newcastle, Pa., in the injuction proceedings of J. J. Dean to prevent the Bell Telephone Company from rescinding a contract for a single party telephone to his place of business at $18 annually. This contract was made a year ago and stipulates the $18 rate "so long as there is opposition in the telephone business in New Castle."

The Bell Company is charging others $42 annually for the same service. Judge Porter holds that the Bell Company cannot violate its contract, simply because it has failed to drive a rival company from the local field.

Submarine Telephony Over Uninsulated Cables

It is reported that telephoning over a bare iron submarine cable has been accomplished by the invention of an Englishman. Using ordinary telephone apparatus, clear speech transmission was obtained, and even the loud speaking reproduction of a phonograph record over eleven miles of this uninsulated cable. From present advices it appears that a thin layer of hydrogen on the surface of the immersed conductor, supplied electrolytically by a polarizing or "pilot" current, performs the function of the usual dielectric—certainly an ideally cheap insulation.

Another advantage claimed is the elimination of electrostatic capacity—a very important point where long distance submarine telephony is concerned.—*Scientific American.*

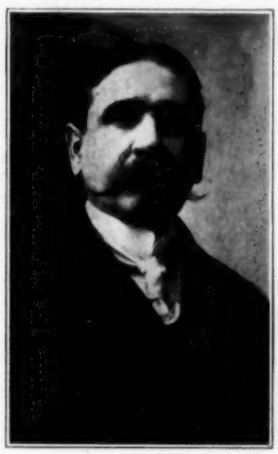
Brevities of the Business

PERSONAL NOTES.

Robert Murray Ferris met an untimely death on the morning of July 13 while bathing at Siasconsett Beach, Mass. It was the first day of Mr. Ferris' vacation and he had joined his family, the night previous, at their cottage there. Having an early morning engagement, he went down to the beach, wearing a bathrobe over his bathing suit, and, not meeting the friend, went into the water alone. No one was on the beach at that time, so further knowledge as to the manner of his death is unknown. His bathrobe was found on the beach by Mrs. Ferris, who went in search of him and of the children and their nurse, who had gone to meet Mr. Ferris with the expectation that they would be home to breakfast with him. Chappaqua, N. Y., was the place of Mr. Ferris' birth thirty-seven years ago. It was the year in which the telephone was invented and Mr. Ferris grew up with the invention, graduating with the degree of bachelor of science from the Massachusetts Institute of Technology in 1897. The New York and New Jersey Telephone Company afforded him a modest start and he made the opportunity a stepping stone to bigger things, one of the first being the study of electrolytic corrosion. He aided in the first common battery switchboard installation in Brooklyn and was given charge of the fundamental plans of the whole Brooklyn plant in 1902. In that same year he was made a member of the expert group placed in charge of the first installing of Pupin coils. In 1907 Mr. Ferris succeeded to the post of chief engineer of the New York Telephone Company, filling the place of J. J. Carty, who assumed a like position with the A. T. & T. Company. When, in 1912, the office of chief engineer for all the companies in the eastern group was created, Mr. Ferris received the appointment. And this was the position he held at the time of his death. It promised great future accomplishment for its holder, who was possessed of especial constructive ability, and who, besides being a leader in his work, was also that in the affections of his many friends. Mr. Ferris was an active member of the Telephone Society of New York, having been president of this body from 1906 to 1908.

Fred Manthei has again taken charge of the telephone exchange at West Bend, Wis. Jens Jensen, the manager, has gone to Port Washington, where he will have charge of the Port Washington and Cedarburg Exchange.

There is one grand old man who has passed on. On Saturday, August 16, James R. Wiley, western manager of the Standard Underground Cable Company, died at the Washington Park Hospital, Chicago, of pneumonia. Mr. Wiley was born in St. Louis in 1847 and was one of the pioneers in the telephone business. He was connected with the Metropolitan Telephone Company, now the New York Telephone Company, for over fifteen years, leaving there to act as western manager for the Standard Underground Cable Company shortly after the World's Fair. Mr. Wiley was a raconteur whose ability was seldom equalled and his acquaintance with men, now considered old men in the telephone and electric light business, but all of whom had entered after "Uncle Jim," gave him a fund of knowledge which made Wiley the center of a circle of interested listeners at every gathering of electrical men. His funeral was held Tuesday, August 19, when a great many of his friends took their last opportunity to certify to their regard for him by accompanying his remains to Graceland cemetery. There are a great many men in the telephone business and in its sister industry, the electric lighting business, who have learned in the years past to call Mr. Wiley "Uncle Jim." He was an uncle to every one of the boys in the game, a friend of every one, and his loss we sincerely regret. Mr. Wiley was a member of the Chicago Association of Commerce, Chicago Electric Club and Telephone Pioneers of America.



R. L. Hidecker has accepted the position of manager of the Rock River Telephone Company. He will have his headquarters in Rochelle, Ill.

George A. French has been transferred from the Duluth office of the Bell Telephone Company, Minneapolis. Mr. French for nine years has been head of the Duluth Telephone Company, which is a subsidiary of the Bell system. Succeeding him will be F. E. Lister, present general manager at Virginia, Minn. Mr. French entered the employ of the Bell Company 18 years ago. Since then he has been promoted repeatedly from minor positions in the east to one of the most prominent places on the Northwestern staff.

Harvey M. Allen, superintendent of the United Telephone Company, Bellefontaine, O., resigned to become superintendent of the Home Telephone Company at Portsmouth.

Fred E. Lister, commercial manager for the Mesaba Range

Telephone Company, will become manager of the Duluth Telephone Company at Duluth, succeeding C. A. French, who goes to Minneapolis as district manager for the Northwestern. Mr. Lister lived at Eveleth before coming to the Range, and has been prominent in both cities and is generally popular. Mr. Lister has been active in commercial club work and is president of the Virginia Commercial Club, being re-elected recently without opposition. His successor on the Range has not yet been named.

J. W. Marlin, president; F. C. Enders, secretary and treasurer, and J. B. Pearson, manager of the Portland Mutual Telephone Company, have been re-elected at the annual meeting of the stockholders and directors at Portland, Tenn.

Samuel J. Blight, contract manager of the Chesapeake and Potomac Telephone Company at Baltimore, Md., has been promoted to the position of district manager, and John R. Brohawn, cashier, has been made sales manager. Mr. Brohawn is the youngest official of the company. He is 28 years old, and has only been with the telephone company since February, 1907. He is married and has one son. Mr. Blight entered the employ of the telephone company in October, 1899, as a clerk in the auditor's office.

John Haines, wire chief with the Rochester Telephone Company, has resigned his position to enter a larger field in the electrical line, having accepted a berth with the Western Electric Company at Minneapolis.

Lalon Z. Farwell, president of the Freeport, Ill., Telephone Exchange Company and one of the oldest telephone men in the West, died in Freeport August 11. He was 77 years old.

H. G. Conger, formerly of Iowa Falls, Ia., and manager of the Central Iowa Telephone Company until he went with the Iowa Telephone Company, has just been appointed commercial manager of the latter company for Iowa. Mr. Conger, on leaving Iowa Falls, went to Des Moines, where he has held a responsible position with the Iowa company. His old home is at Manchester, where he first entered the telephone business. His rise has been rapid and is due to a thorough understanding of the business and splendid executive ability.

J. E. Campbell, of Mississippi, recently stationed at Milan, has been made county manager for Weakley of the Cumberland Telephone Company, with headquarters at Sharon, succeeding Mr. Berry, who has been in charge of the county exchanges for the past three months.

J. Reasoner, the principal stockholder in the Ord Independent Telephone Company at Ord, Neb., has sold his interests to Allen C. Walker of Fairbury, and tendered his resignation.

Frank M. Farwell, aged 45 years, the Bell Company's division superintendent of traffic at Kansas City, Mo., died on August 2.

L. H. Baldwin, northwestern representative Kellogg Switchboard & Supply Company, has returned to San Francisco from an extended business trip in the northwest.

NEWS FROM THE FIELD.

ARKANSAS.

The movement begun several months ago, looking to a merger of Texarkana's two telephone systems, has not yet attained fruition, and it is doubtful if ever it will do so. The state authorities of Texas were induced to agree to the consolidation, but the City Council of Texarkana, Ark., at a recent meeting, voted against allowing a charter for the consolidated companies unless better rates were made in the proposed franchise.

CALIFORNIA.

Glendale's rapid growth is shown by the large number of telephones that have been installed during the five years' life of the local branch of the Pacific Telephone and Telegraph Company. At this time the company has 1,600 stations and is handling 20,000 calls per day.

The Pacific Telephone and Telegraph Company was ordered by Judge Sturtevant to show cause why it should not restore telephone service to the Hotel Alexander, on Geary street, San Francisco. The hotel filed suit for $5,000 damages, alleging that the company shut off its service on August 11, when the hotel refused to pay bills it declares were exorbitant.

The Pacific Telephone and Telegraph Company completed the establishing of toll or long distance connections with the Consolidated Utilities Company of Compton. This company operates three local telephone exchanges in Compton, Gardena and Hynes, and has over 900 subscribers located in those towns and in Clearwater and Moneta.

It is announced that one of the first undertakings of the California Telephone & Light Company when it secures control of the Cloverdale Light & Power Company's lines is to extend the lines along Dry Creek valley and down the western side of the river into the Healdsburg section.

DELAWARE.

Pennsylvania Telechrophone Company, Wilmington, Del.; capital, $1,500,000.

ILLINOIS.

Double Phone Sales Company, Chicago, $2,500; telephone appliances and devices; David Swarts, Sol Greer, John A. McCarm.

Work on the rehabilitation of the East Moline plant of the Central Union Telephone Company will begin within two months, according to A. J. Beverlin, who is in charge of the company's interests here. It is planned to expend $75,000, providing for the growth of the city for at least five years. A new exchange building and the placing of some of the wires in the business district under ground are contemplated. Mr. Beverlin believes that the company should provide for at least 2,400 subscribers at the end of five years.

Ground has been broken at Rock Island for the new exchange building which the Central Union Telephone Company will erect at Seventh avenue and Eighteenth street at a cost of $45,000. The structure will be 70x90 and will be two stories in height.

H. P. Hansen of Elgin proposes to refuse to pay his Northwestern telephone bill for July on the grounds that most of the telephones of his patrons, principally the country, were out intermittently during the whole month, thus making his telephone practically valueless to himself. His action will raise a new point and the outcome will be watched closely by other subscribers who complained that they could not reach residents outside the city after the storm.

The Central Union Telephone Company at Sterling announces that the toll rate between Sterling and Morrison had been reduced five cents and that hereafter the charge for a talk with Morrison parties will be but ten instead of fifteen cents. Two more circuits between Sterling and Dixon are also contemplated and will probably be installed next season.

Flatwoods and Ray Telephone Company, Ray, $450; a farmers' mutul telephone company. Incorporators, W. F. Aten, George E. Cook and Adam P. Seasley.

The telephone company at Burgess changed switchboard from Ed. Hines' residence to J. E. Gladson's residence.

INDIANA.

The Home Telephone Company of Elkhart have received bids for a $35,000 building in which it will install a new exchange, to cost about $60,000.

A building permit has been issued to the Indianapolis Telephone Company for the erection of a four-story concrete building in the rear of the present building in North Meridian street. The building is to cost $35,000.

IOWA.

The Shambaugh Central Telephone Company has been organized with a capital stock of $10,000 divided into shares of $8 each, for the purpose of carrying on what is known as the rural telephone business in Shambaugh. M. G. Palmer is the president; S. R. Turner, vice-president; George W. Reed, secretary-treasurer, and R. A. Duncan, Henry McKeown, Arthur Pfander, Frank McCurdy, Thomas C. A. Pace, Ezra Hardee, Ed Boe, Alex Pinkerton, T. R. Young and Martin Eberly, directors. The company proposes to put in new poles and wires in its system in Shambaugh.

If the present plans are carried out, Tabor will have a second telephone system in the near future—a mutual. The promoters of the mutual system have the assurance of the support of a majority of the citizens of Tabor.

The town council of Albia has been asked to take a hand in controlling the price of telephone service. The council is investigating matters and finding out what they can do about it.

A telephone system which is being installed between Des Moines and Oelwein by the Great Western is nearly ready for operation. When the system is completed it will enable the company to tap a wire anywhere along the line and secure telephonic communication with the dispatcher's office. The service will be used with the telegraph in directing the movements of trains. One valuable feature of the system is that in case of an accident between stations communication can be quickly established by the train crew with the operating officials. Each

freight caboose is supplied with apparatus necessary to make the connections.

The Hedrick Telephone Company is preparing to make extensive improvements this fall. It has received 3,750 feet of new cable, which will enable it to do away with many wires.

KANSAS.

The Russell Telephone Company is putting in a new metallic cable from the B. F. Himes corner south to the city limits. The cable is made up of 150 small copper wires, arranged in pairs, wrapped separately and these are covered with a coating of lead.

An investigation into telephone rates all over the state has been started by Henderson Martin, chairman of the public utilities commission. Chairman Martin believes that the rates in different sections of the state vary too widely, and if the results of his investigations bear out this belief, he intends to take some action toward standardizing the rates.

MARYLAND.

The City Council of Cumberland has granted a franchise to the Chesapeake and Potomac Telephone Company to lay a conduit through Wineow and Thomas streets. The company has a conduit through the heart of the city. Commissioner Thomas W. Koon opposed granting the franchise, claiming it was too valuable to give away and he criticized the service the company is giving.

The Severna Park Telephone and Telegraph Company applied to the Public Service Commission for permission to sell its property and franchise to the Chesapeake and Potomac Telephone Company for $900.

MONTANA.

The Montana Independent Telephone Company operates the automatic system at Butte and requires not more than a dozen operators and is in direct connection by long distance with every city in the state. Some conception of the popularity of the automatic telephone is indicated in the 60,000 calls during 24 hours in the local office, and the number often reaches 20,000 an hour. Manager F. E. Farwell is the local head of the Montana Independent Telephone Company and has a force of 35 people on his payroll.

MICHIGAN.

One of the features of the 100,000 new telephone directories distributed to telephone users of Detroit, is the abolishing of the letter "L" as a designation for party lines, and the substitution of "M." There has been considerable confusion between the "L" and "R" letters and the "M" is expected to reduce the chances of error.

The Michigan State Telephone Company is installing new switchboard equipment that will cost $175,000. The new work is divided as follows: Cedar exchange, one section of switchboard and additional multiple answering jacks, $30,643; West office, underground conduit, underground cable, central office equipment and rearrangement of present equipment, $3,000; Hickory exchange, three sections of switchboard and 3,900 multiple answering jacks, $41,000; main office, additional switchboard equipment, $600; Hemlock office, additional switchboard equipment, $33,532; Ridge office, additional switchboard equipment, $45,778; North office, additional switchboard equipment and trunk line facilities, $29,438.

The council of Hillsdale has submitted a proposed franchise to the Michigan State Telephone Company.

The merger of the two telephone plants at Adrian, Mich., formerly owned by the Bell and Adrian Telephone Companies, has been consummated. A dispatch from Grand Rapids is to the effect that the Michigan State or Bell Telephone Company will sell its Grand Rapids property to the Citizens' and in exchange will secure control of the field in Battle Creek, Jackson and Marshall, where the company holds the majority of stock. This deal, if effective, will unite 9,000 Bell subscribers in Grand Rapids with the Citizens, or independent company.

The Southern Michigan Telephone Company is putting in a lot of repairing on its system at Sturgis. The most important is the placing of underground conduits.

When contemplated changes are made in the Portage Lake system of the Michigan Telephone Company, a plant costing upwards of a quarter of a million dollars and serving 3,200 subscribers will have been provided. Additional armored submarine cable of the largest size will be laid across the Portage river, and additional underground conduit is to be laid both in Houghton and Hancock, carrying additional underground cables of large size.

The Michigan State Telephone Company, which has a number of extra men employed in Ishpeming and Negaunee, installing new switchboards and doing other necessary work, has appropriated $5,000 for the new office equipment being installed in the Ishpeming central in the Thoney block, and $13,000 has been appropriated for the outside work in Negaunee.

MINNESOTA.

Because a municipally-owned telephone company cannot be classed as public property used exclusively for public purposes, the city of Barnesville must pay a gross earnings tax to the state, according to the opinion given at St. Paul by Assistant Attorney General Stevenson. Since 1903 Barnesville has refused to pay the tax, claiming that the enterprise was public in its nature. More than $1,700 in taxes has accrued in that time.

The completion of 30 miles of telephone line into the dense woods of Cook county in the northern part of the state will be of incalculable value to the state and settlers in the matter of fire protection, according to the state forestry department officials. The line extends to the Canadian border, where it connects with the Dominion telephone system. Instruments have been placed in the homes of the few settlers in that region. The state now has 285 miles of telephone line in the forest region. The last legislature appropriated $25,000 for extension work.

The Duluth Bell Telephone Company is installing a telephone exchange at Gary. The subscribers of this place, New Duluth and Fond du Lac centered from the Gary exchange which will give a better and quicker service.

The Minnesota Telephone Company has determined to construct a telephone exchange in Brainerd connecting with the Tri-State lines and in competition with the Northwestern Telephone Exchange Company. The new company has filed with the council its plat of proposed lines on streets and alleys and is operating under a franchise secured by H. F. Mann years ago.

MISSOURI.

Contracts have been awarded by the Kansas City Home Telephone Company for the installation of semi-automatic switchboards in their Main and South exchanges. The new switchboards are equipped with a keyboard similar to that on an adding machine. When the patron gives a number to the operator, she presses a button and the connection is made. The system is known as the automanual interexchange trunking system, and it has been in successful use in some of the smaller cities of the country.

The new $200,000 exchange the Southwestern Telegraph & Telephone (Bell Company is preparing to open at Carter and Fair avenues, St. Louis, will serve approximately 1,800 subscribers, and the equipment provides facilities for 500 additional telephones.

NORTH DAKOTA.

There are some differences between the city officials of Bismarck and the management of the North Dakota Independent Telephone Company, which conducts the local exchange there. Years ago the city granted a franchise to Ed. Allen for a local exchange and under that franchise the city officials were to have use of the long distance service without charge. The company has changed hands a number of times and was finally taken over by the North Dakota Independent Company, which is still operating in this city under the old franchise granted to Allen. The local exchange has threatened to eliminate this free service to the city. The officials are resisting such a proposition and the result will probably make it necessary eventually for the present telephone management to secure a new franchise from the city.

The Tri-State Telephone Company has opened a long distance exchange in Crookston, the long distance service between Grand Forks and that place having been established. The establishment of a local exchange in Crookston is still a matter of conjecture, the franchise, asked by the company, not having as yet been granted.

The North Dakota Independent Telephone Company is contemplating the organizing of several farmers' telephone lines out of Mott in the near future.

OHIO.

Attorneys for the Brownsville Farmers' Telephone Company, which operates lines in Southeastern Licking county, filed a request with the Newark Telephone Company, that the latter corporation be made to show cause why they have not carried out an agreement made five months ago whereby the companies interchange service.

NEW YORK.

Workmen have started the erection of a five-story addition in the rear of the New York Telephone Company's building at 120 Bleecker street. The addition is to be 35 by 33 feet, built of brick and at an estimated cost of $35,000. It is to provide more switchboard and exchange room and will furnish additional space on the office floor.

The Keystone Telephone Company reports for the seven months ended July 31 net earnings of $360,558, against $347,885 in 1912.

The York Telephone Company has within the last year established a number of rural telephone lines out from Dillsburg, and at present has a force of men building additional lines. One of these rural lines, which extends through Monaghan township, keeps the Dillsburg operator guessing many times. The line has 14 subscribers, and 12 of them have the name of Myers and several of them have the same given name.

OREGON.

In compliance with a provision of the city charter of Portland, requiring all companies holding city franchises to make a report of such holdings, the Home Telephone & Telegraph Company and the Portland Central Heating Company filed reports with City Auditor Barbur showing in detail the property belonging to the companies and the franchise rights held.

C. R. Seitz, supervisor of the Cascade National forest; Charles H. Flory, Chief Forester for Oregon and Washington, and S. C. Bartrum, supervisor of the Umpqua forest, have arranged for the extension of the present McKenzie Government telephone line from the summit to Sisters, in Eastern Oregon, where connections may be made with portions of the Cascade, Santiam, Deschutes and Umpqua forests east of the mountains. At present telephone calls to forest officers east of the range have to go by way of Portland and The Dalles, consuming much time, and the construction of 15 or 20 miles of telephone line will do away with this trouble.

NEW JERSEY.

At a meeting of the Cumberland County Board of Freeholders an ordinance to grant the Bell Telephone Company permission to use the county roads for their lines was tabled. The company offered the county three telephones free of charge.

PENNSYLVANIA.

The Reading Railway Company will shortly introduce a telephone system for running its trains, and experimental lines will be constructed on its Shamokin division.

W. F. Bush, district manager of the Bell Telephone Company of Pennsylvania, stated that an appropriation of $7,000 has been made by his company for replacing the toll line between Reading and Birdsboro for the providing of additional toll service between Reading and Pottstown.

The Keystone Telephone Company has opened an exchange at Hatboro, starting with 60 subscribers.

The business offices of the Consolidated Telephone Company of Pennsylvania at Scranton have been removed from the ground floor to the fifth story of the old Republican building on Washington avenue. Their offices will occupy the entire fifth floor, giving them ample room in which to take care of their ever increasing business. The sixth floor of the building is devoted to the exchange and now the entire two floors are devoted to the business of the company.

The Bell Telephone Company is spending $20,000 in improvements on its line between Bethlehem and Allentown.

TENNESSEE.

There is growing complaint in Cleveland among the patrons of the Cumberland Telephone Company because of poor service, and the city council is demanding either better service or that the company withdraw from the city. If better service cannot be secured it is decidedly a matter of short time when a corporation will be organized and a new system will be put into operation.

A new copper circuit between Memphis and Somerville, has been finished and put into service on the switchboards of the Cumberland Telephone and Telegraph Company. The addition of this new circuit to the company's existing wires gives Somerville an outlet to Memphis over two direct copper lines, and the congestion of business which has sometimes been felt in the busy season will be alleviated.

The Sulphura Mutual Home Telephone Company, Sulphura; capital, $1,000; incorporators, J. W. Simpson, J. W. Ryan, J. W. Brizendine, A. H. Hodges, B. E. Simpson.

Frentress Branch of the Home Telephone system, Frentress county; capital, $1,500; incorporators, G. H. Boles, E. J. Clark, S. P. Allred, A. A. Peaveyhouse, G. W. Reagan.

TEXAS.

J. D. Horn was granted permission by the county commissioners to erect a telephone line along the Horn, Fest and Basse roads, San Antonio. The work will be done under the supervision of the county roads superintendent.

The Southwestern Telegraph and Telephone Company has begun work of stringing a toll line from Orange to Newton on the Frisco Railroad.

The Orange Home Telephone Exchange, valued at about $30,000, has been sold to the Brazos Valley Telegraph and Telephone Company. Miss Alma Mason, who was formerly chief operator, has been employed as local manager. The new owners propose to put the exchange in first-class condition.

The S. A. Robertson Company, to which company franchises for the maintenance, operation, etc., of telephone, electric light, water and power systems at San Benito were recently given, in return for certain concessions and considerations, has returned the franchises to the city council. The San Benito Land and Water Company, it is supposed, will continue to operate the local public utility systems.

The Southwestern Telephone Company is making extensive improvements in its plant at Houston, which will be rebuilt. The poles will be taken off the street, some of them set inside the sidewalks and others installed in the alleys in the business section.

The Union Telephone Company of Collin and Grayson counties, which was granted a franchise by the city council of Van Alstyne several months ago, has begun work on its proposed extension to this place. Excavating for the laying of conduits is now in progress, and the management of the company announces that a local exchange will be installed in addition to the long-distance service they now have to this town.

Mr. Waldron, manager of the Gulf States Telephone Company at Hamilton, is seeking to make arrangements for the extension of the lines along the route of the Temple, Northwestern & Gulf Railroad from Temple to Hamilton.

WASHINGTON.

At a cost of approximately $100,000, the Pacific Telephone & Telegraph Company has announced its intention to construct an additional exchange building on Capitol Hill, Seattle. It will be situated on the west side of Tenth avenue, between East Prospect and East Highland Drive. When finished and equipped the structure will have a capacity of service to 4,400 subscribers.

Although Lewis county has more miles of rural telephone lines than any other county in the state, two more lines will shortly be built. The county commissioners have just granted franchises to the Rainy Valley Telephone Company for a line from Fulton ferry across the upper Cowlitz river to Randle, by way of the river road, and the Hanaford-Skookum Telephone Company to construct a line to accommodate farmers and others living northeast of Centralia, in the Hanaford valley.

WISCONSIN.

The Rock County Telephone Company is asking permission to do the necessary excavating for an underground telephone system in Janesville. The communication was received and placed on file. It will be acted upon at a later date.

The city council of Appleton has appealed to the state rate commission in an effort to compel the Wisconsin Telephone Company to connect with the private system now in the city hall. At the present time the city is paying $30 a year for the one line running to the exchange in the building. The telephone company insists on taking out that system, putting in one of its own and charging $182 a year as soon as the physical merger of the Wisconsin and Fox River Telephone Companies is completed.

A telephone system and exchange was ordered by the school board building committee of Milwaukee for the Prairie Street school building, which is soon to serve as administration headquarters of the board. Its cost is estimated at $4,000. Under the system now in use each school building possesses a "pay" phone on a party line which Director Raasch said is unsatisfactory. Cement work contracts on various proposed new buildings were let to the approximate value of $40,000.

WYOMING.

The Mountain States Telephone and Telegraph Company, which is now engaged in rebuilding the line from Laramie to Rawlins, will probably commence work of improving the line between Cheyenne and Laramie.